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OCT. 1981

COMPUTER DESIGN

THE MAGAZINE OF COMPUTER BASED SYSTEMS



IN-SITU EMULATION PACES NEW MICROS

CARTRIDGE TRANSPORT DISC BACKUP

PROJECT MANAGEMENT SKIRTS SOFTWARE PITFALLS

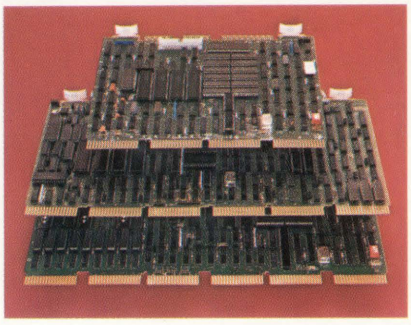
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Now there's an advanced technology family of single board controllers for DEC* computers from Western Peripherals—the number one name in controllers.

The TC-131 (for PDP-11s*) is the first TM-11 emulating controller to combine PE and NRZ on one standard hex board. It lets you mix 9-track, PE, NRZ or dual density tape units in any combination up to 125 ips. A 64 byte data buffer allows installation at any point on the unibus without consideration of NPR priority.

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*Trade name of Digital Equipment Corporation.

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Kennedy was the first to utilize the ¼″ 3M cartridge for disk backup; Kennedy was the pioneer in Winchester disk technology, and was a leader in developing a low cost streaming tape drive.

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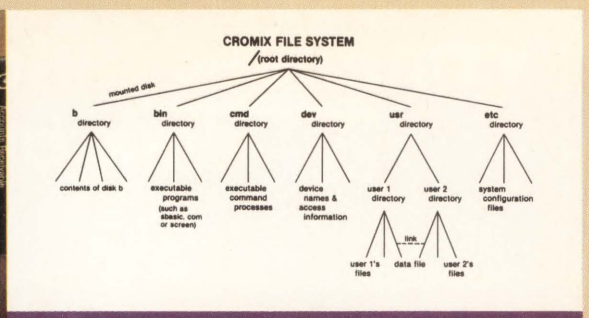
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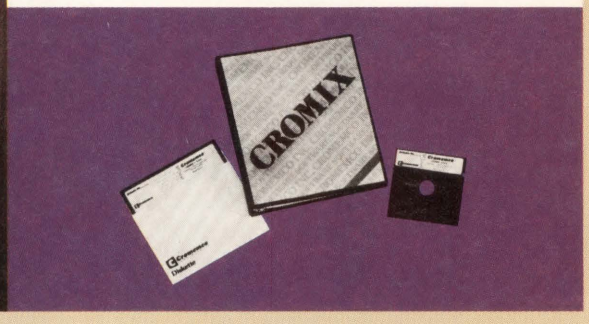


KENNEDY • QUALITY • COUNT ON IT

CIRCLE 2 ON INQUIRY CARD







CROMIX*— Cromemco's outstanding UNIX†–like operating system

CROMIX is just the kind of major development you've come to expect from Cromemco. After all, we're already well-known for the most respected software in the microcomputer field.

And now we've come up with the industry's first UNIX-lookalike for microcomputers. It's a tried and proven operating system. It's available on both 5'' and 8'' diskettes for Cromemco systems with 128K or more of memory.

Here are just some of the features you get in this powerful Cromemco system:

- Multi-user and multi-tasking capability
- Hierarchical directories
- Completely compatible file, device, and interprocess I/O
- Extensive subsystem support

FILE SYSTEM

One of the important features of our CROMIX is its file system comprised of hierarchical directories. It's a tree structure of three types of files: data files, directories, and device files. File, device, and interprocess I/O are compatible among these file types (input and output may be redirected interchangeably from and to any source or destination).

The tree structure allows different directories to be maintained for different users or functions with no chance of conflict.

PROTECTED FILES

Because of the hierarchical structure of the file system, CROMIX maintains separate ownership of every file and directory. All files can thus be protected from access by other users of the system. In fact, each file is protected by **four separate access privileges** in each of the three user categories.

TREMENDOUS ADDRESS SPACE, FAST ACCESS

The flexible file system and generalized disk structure of CROMIX give a disk address space in excess of one gigabyte per volume — file size is limited only by available disk capacity.

Speed of access to disk files has also been optimized. Average access speeds far surpass any yet implemented on microcomputers.

'C' COMPILER AVAILABLE, TOO

Cromemco offers a wide range of languages that operate under CROMIX. These include a high-level command process language and extensive subsystem support such as COBOL, FORTRAN IV, RATFOR, LISP, and 32K and 16K BASICs.

There is even our highly-acclaimed 'C' compiler which allows a programmer fingertip access to CROMIX system calls.

THE STANDARD O-S FOR THE FUTURE

The power and breadth of its features make CROMIX the standard for the next generation of microcomputer operating systems.

And yet it is available for a surprisingly low $595.

The thing to do is to get all this capability working for you now. Get in touch with your Cromemco rep today.

*CROMIX is a trademark of Cromemco, Inc.
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CIRCLE 3 ON INQUIRY CARD

UP FRONT

ASTM to develop test method for emi shielding

As a result of the FCC regulation restricting rf emission from computing devices, the ASTM committee D-9 on electrical insulating materials has authorized a new section to develop a test method for determining the emi shielding effectiveness of filled nonconductive planar materials or coating systems applied to those materials.

2400-baud direct connect modems

FCC registered 2400-baud modems announced by the Electronic Devices Div of Rockwell International include a protective circuit that allows direct connection to the U.S. telephone network or 2-wire private lines.

Second-sourcing agreements

Signetics Corp and Advanced Micro Devices have agreed to a technology exchange that allows each company to manufacture certain bipolar microprocessor related products of the other. Advanced Micro Devices will alternate-source Signetics' 8X300 microprogrammable microprocessor and Signetics will second-source Advanced Micro Devices' Am2960, Am2964B error detection and correction unit and dynamic memory controller. Both companies expect to be sampling parts by the second half of 1982.

Intel Corp and Texas Instruments Inc have agreed in principle to manufacture and market two versions of a combination codec/filter with common pinout and functionability. A synchronously clocked version will have 20 pins while an asynchronous version will have 24. The devices will incorporate all functions of the direct mode Intel 2910A and 2911A codecs and the 2912 industry standard filter. They will be pin selectable to conform to both μ-Law and A-Law specifications.

New ANSI COBOL standard available for public review

American National Standard Committee X3, Information Systems, will conduct a 4-month public review of a proposed new COBOL standard prior to voting on approval of the document. Intent of the proposed American National Standard is to provide a revision to X3.23-1974 that contains improved capabilities and modifications to the existing specification. Added capabilities include structured programming constructs, nested programs, and reference modification. Modifications improve definition and use of the language.

Written orders for copies of the proposed standard should be sent to X3 Secretariat, CBEMA, 1828 L St NW, Suite 1200, Washington, DC 20036, Attn: dp ANS X3.23-198X, and should include $25/copy payable to X3 Secretariat. (All comments on the draft standard must be submitted to the X3 Secretariat no later than Feb 13, 1982.)

"Club" chooses mechanical specs for 5.25" cartridge

Seagate Technology, DMA Systems, and Dysan Corp have announced their agreement on mechanical specifications for the 5.25" (13.34-cm) MicroDisc removable disc cartridge. The club formed by these three companies chose cartridge dimensions of 5.551 x 5.394 x 0.748" (14.096 x 13.701 x 1.899 cm) with a single magnetically clamped oxide coated disc within the plastic housing. Disc rotation is specified at 3600 r/min and the certified recording area is from 1.300" (3.302 cm) inside radius to 2.450" (6.223 cm) outside radius.

UP FRONT

Memorial fund for computer pioneer

Richard E. Merwin, president of the IEEE Computer Society and a pioneer in the field of digital computers, died on Aug 28 of complications following open heart surgery. He began his career working on ENIAC at the Moore School of Engineering and later organized the engineering team for the Maniac computer at the Los Alamos Scientific Laboratory. At IBM he was engineering manager of the Stretch program, a major influence on the IBM 7090 generation of machines. Most recently he was research professor in computer science at George Washington University.

A memorial fund is being established in Dr Merwin's name by the IEEE Computer Society to support research and engineering in computer science. Donations should be sent to the Richard E. Merwin Memorial Fund, with checks payable to the IEEE Computer Society, PO Box 639, Silver Spring, MD 20901.

JAN approval for memory products

Intel Corp has received JAN approval for its 100-ns access time 3636 16k-bit bipolar P/ROM and 45-ns access time 2147H series 4k-bit static RAM. Military part numbers assigned by the Defense Electronics Supply Center for the two devices are M38510/21002BJB and M38510/238BVB, respectively.

Pretriggers

Control & automation

An intelligent, low cost, industrial robot from International Robomation/Intelligence uses an internal microcomputer network to control movements on five axes. It is said to offer the capability of traditional heavy industrial robots at an untraditional price.

Eliminating a common cause of system failure by storing programs in P/ROM instead of on disc allows a control system from Analog Devices to provide 16-bit multitasking operation in harsh environments.

A Special Report on Control & Automation highlights digital technology in process control, CAD, touchpad control, a smart A-D, a talking console monitor, an airborne data acquisition system, and computerized vision.

Data communications

A low cost local network targeted for the office environment is expected to result from introduction of a number of network components by Datapoint Corp and from the decision by Tandy Corp to link its TRS-80 model II microcomputers onto Datapoint's ARCNET.

Development systems

A voice development system will enable users to program vocabularies in their own digitized voice on chips, according to Centigram Corp.

ROM simulation is claimed by Step Engineering to eliminate the need for microprocessor personality modules, enabling a single instrument to integrate firmware for all 4-, 8-, and 16-bit microprocessors, as well as bit slice processors, without hardware changes.

Interface

Dual-mode image array selection through software allows users of Raster Technologies' graphics controller to handle both imaging and line drawing on one display monitor.

Peripherals

A true 3-dimensional display system from Genisco Computer Corp allows the operator to see different perspectives by moving his head in relation to the image projected from an electrostatic vector CRT onto a flexible, variable focal length mirror that vibrates at 30 Hz.

System elements

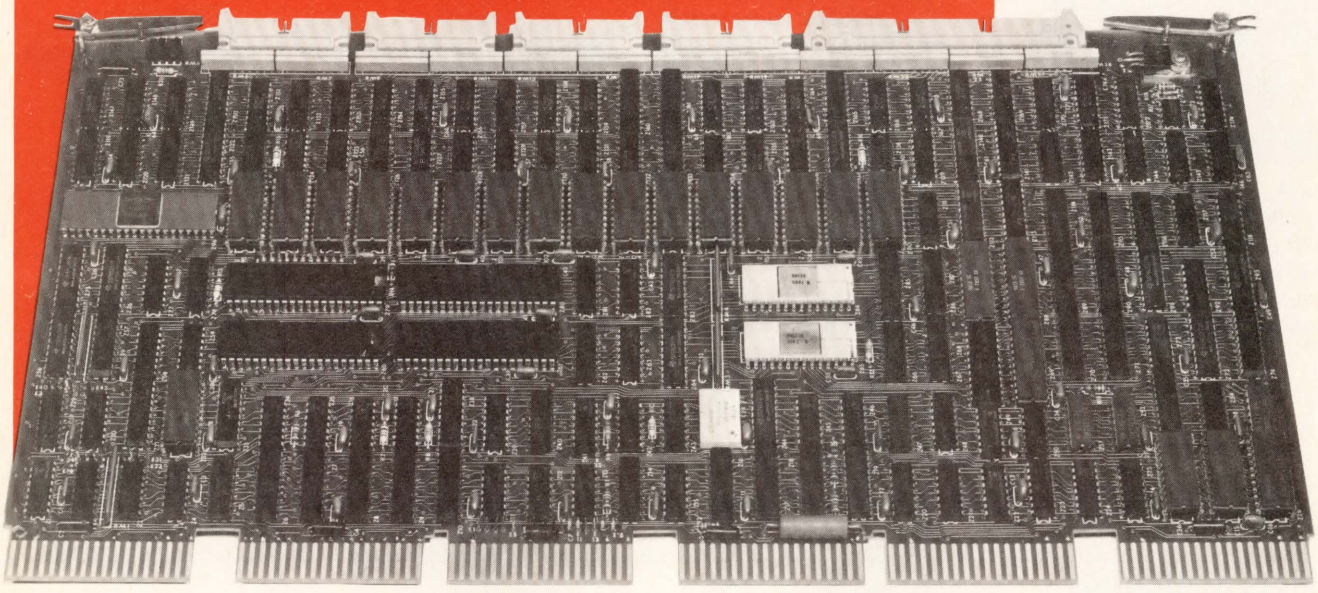
Complex optical assemblies are eliminated by CCD chips developed by Itek Corp that mount side by side, forming rugged sensors with 10,000-pixel resolution.

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A FAMILY OF SOFTWARE-COMPATIBLE SMD CONTROLLERS FOR PDP-11 AND LSI-11

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It is a proven family, started in mid-1979 with the S33/A, the industry's first DEC-compatible, single-board SMD controller with complete software compatibility. And evolving to today's eight price-performance leaders — four single-board PDP-11 compatible controllers and four dual-quad LSI-11 controllers, with RM02, RK07, RP06 and RK06 emulation.

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If you need SMD capability for your PDP-11 or LSI-11, one of our family of SMD controllers can fit right in. Call us today.

	RM02/05	RK07	RP06	RK06
PDP-11	S33/A	S33/B	S33/C	S33/D
LSI-11	S03/A	S03/B	S03/C	S03/D

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CIRCLE 4 ON INQUIRY CARD

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System technology

32 Microprocessors/microcomputers: **Personal computer based on 16-bit CPU supplies power and potential**
A step toward the ultimate personal computer
Desktop computer combines word processing with graphics functions

46 Interface: **Analog input card uses MUX channel file and dual-port RAM to double Q-bus bandwidth**
Remote printer system saves line costs, eliminates host degradation

60 Integrated circuits: **N- and CMOS standard cells provide multiple interconnect methods and unrestricted die size**

70 Data conversion: **Q-bus compatible interface controls three channels of resolver conversion**

76 Control & automation: **Industrial control computers reduce costs through fault tolerant techniques**

78 Software: **Software products enable DPS 6 and Level 6 computers to operate in SNA environment**

90 Development systems: **Logic development system adds emulation for three 16-bit microprocessors**

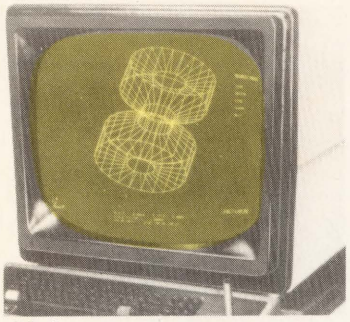
98 Memory systems: **Virtual storage system reduces data storage costs, speeds access functions, increases disc utilization**

104 Test & measurement: **Logic analyzer/pattern generator combination simulates/evaluates hardware/firmware responses**

110 Data communications: **X.21, X.25 data transmission options are available for IBM systems**
Dial-up diagnostics pinpoint faults in remote data networks

120 Peripherals: **Cartridge module adds versatility to dot matrix printing techniques**

126 EMI protection: **Computer systems design and the law**



124 *An interactive 3-D graphics design workstation with complementary engineering/drawing software simplifies intelligence for standalone operation*

System design

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141 Memory systems: **Cartridge transport disc backup**
by Darell Meyer—Obvious choices do not guarantee effective tape cartridge backup. In some cases, an economical transport can be preferable to a high performance unit

149 Software: **Project management skirts software pitfalls**
by Craig Shermer, Michael A. Neighbors, and Robert Maitland—Turnkey system development method combines engineering and management expertise to reduce schedule delays and cost overruns

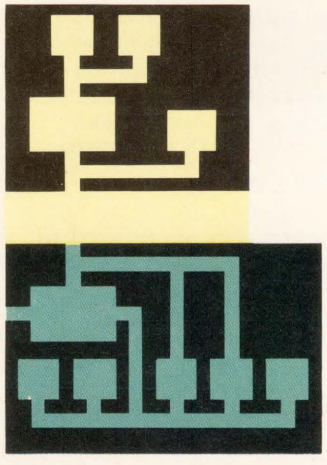
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by William S. Ang—A hierarchy of buses and a triple-bus interface overcome multiprocessing drawbacks

186 Microprocessors/microcomputers: **4-bit micro adapts to 8-bit world**
by Walter J. Niewierski—An I/O expansion technique customizes a 4-bit device for 8-bit operation



180 *Customizable multiprocessing architecture accommodates a master processor and subordinate processors—all based on a common microprocessor element*

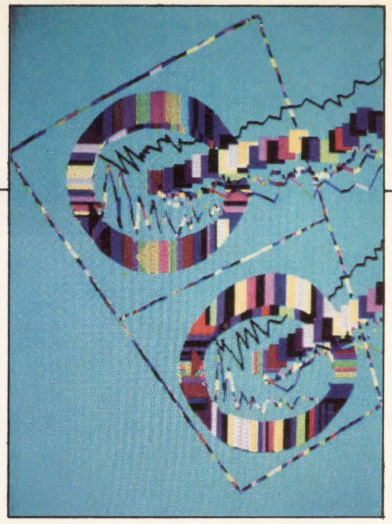
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IECI '81

188 System design engineers from nearly 20 countries will discuss microprocessor and microcomputer applications in industrial control and instrumentation

MIDCON '81

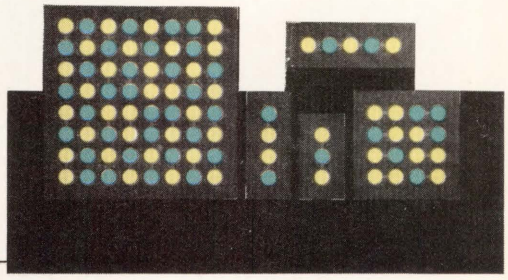
196 Both the professional program and the industrial exhibits will emphasize technological interests of mid-West design engineers



This month's cover, entitled "Emulation," was generated on a Digital Effects VP-3 by Larry Gartel

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266 *Membrane switch package features cover that allows use of an existing PCB to form the base or stable layer*

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New this month: Designers' Preference Survey

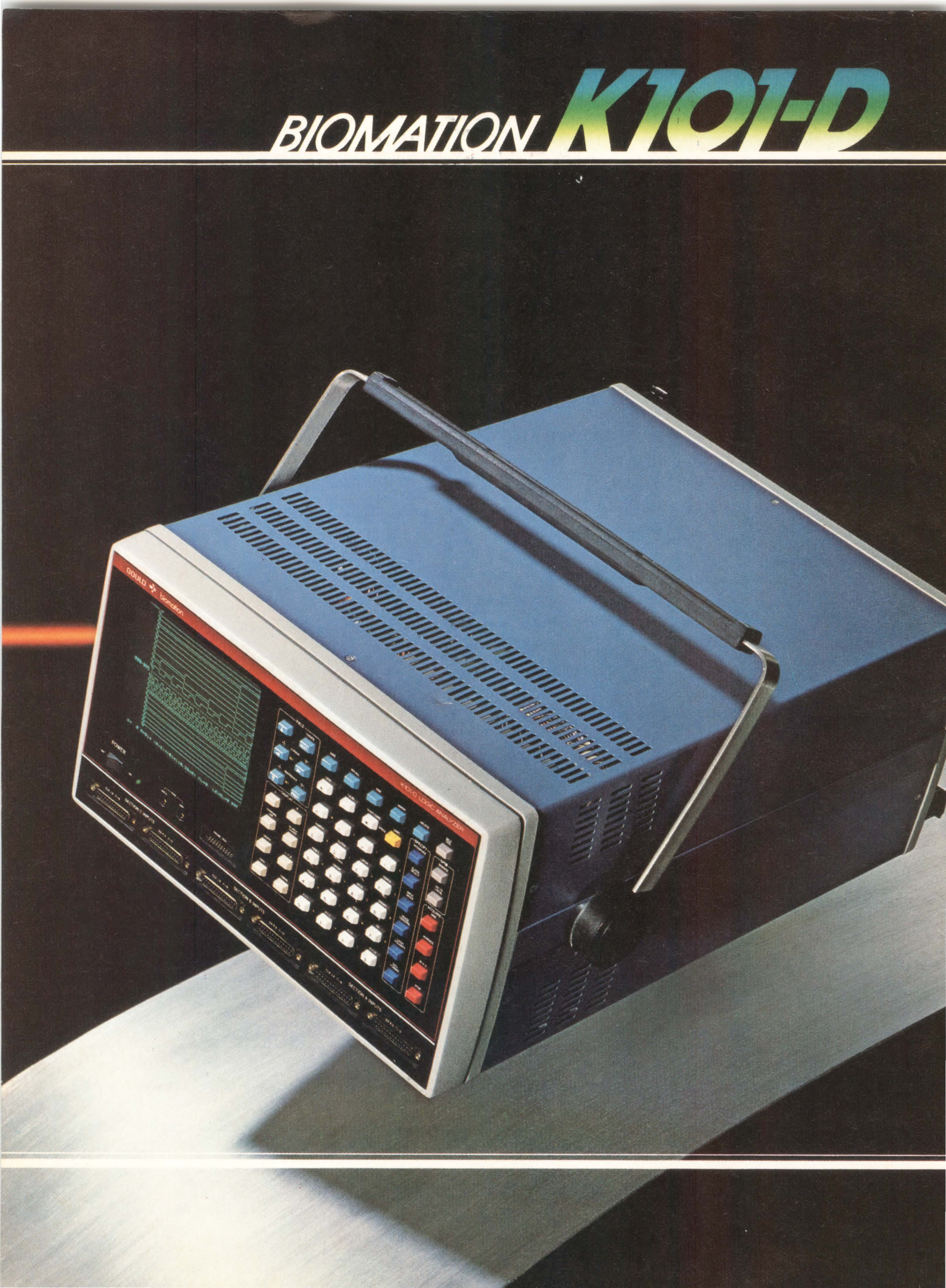
219 **Plug compatibility study**

Editorial reviewer for this issue: Fred F. Coury

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BREAKTHROUGH

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It's here. Biomation K101-D. The first logic analyzer to combine high-speed 50 MHz data and 100 MHz time domain capabilities with advanced 48-channel recording. With enough powerful extras to demolish your toughest hardware/software integration problems—even on the most complex multiplexed microprocessor.

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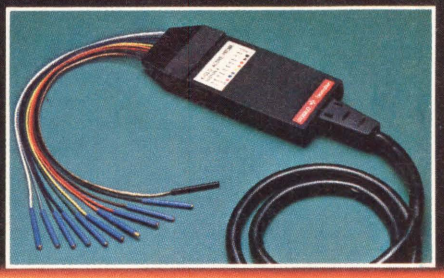
With its 50 MHz clock rate, 48-channel recording and 16 triggering levels, the K101-D isolates software bugs faster and more precisely than ever before. Sophisticated disassembly firmware generates precise mnemonics that cut analyzing time. And 12 external clocks (AND or OR) let you demultiplex 16-bit microprocessors, 16- and 32-bit minicomputers and bit-slice processors.

100 MHz high-speed hardware analysis.

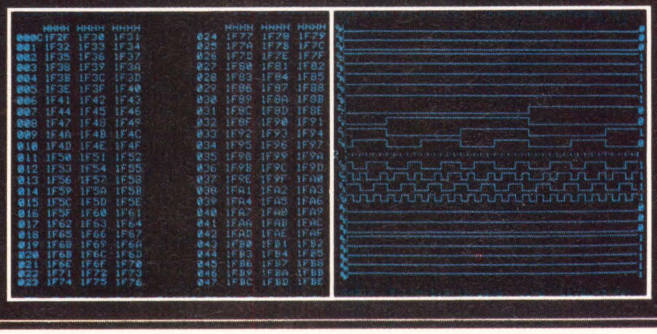
The K101-D's advanced high-performance hybrid probes let you capture glitches as narrow as 5 ns. And, with 48-channel recording, 515-word memory and 16-level triggering, you'll trap the data you need. The convenient display formatting and expansion simplify analysis.

Call now for a free demo.

See for yourself why the K101-D is a breakthrough in logic analyzers for the years ahead. For a demonstration or a copy of our detailed product brochure, write Gould Inc., Biomation Operation, 4600 Old Ironsides Drive, Santa Clara, CA 95050. For fastest response, call 408-988-6800.



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The CGC7900 is the equivalent of a full-blown minicomputer with the latest in color graphics capability. A 10 megabyte hard disk and dual double-density 512K byte flexible disk drive can also be added to create large local data bases or to load programs. The CGC7900 is assembled as an integrated system and utilizes DOS or the IDRIS general purpose operating system designed especially for the MC68000 CPU. PASCAL and C Compilers are supported.

At last, price is no longer an issue when choosing between medium and high resolution graphics. Now Chromatics offers you much more resolution, power, speed and versatility with the CGC7900-1 for only $14,995.

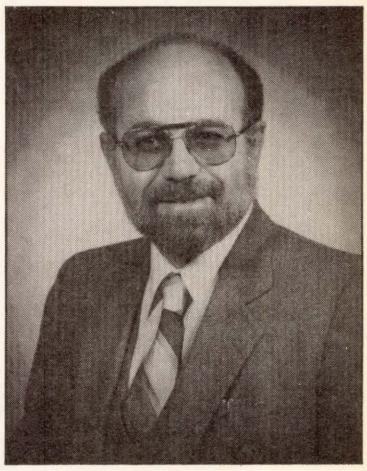
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BREAKTHROUGH

CIRCLE 6 ON INQUIRY CARD

S IS FOR SCOTLAND, SCOTCH, AND SILICON



I recently spent a week in the country that gave the world the steam engine, international economic theory, and the chief engineer of the *Star Ship Enterprise:* Scotland. Now from Scotland come more innovations that could make that country the world's leading source of semiconductor technologists, as well as the Silicon Valley of Europe.

The historic ground of Edinburgh University and its unique Wolfson Microelectronics Institute is an internationally acclaimed site of higher technical education. Added to that, Scotland is making a precedent-setting bid for worldwide technology through a series of highly inviting industrial, educational, and financial incentives to industry, such as 100% write-off on plant facilities and machinery during the first year. Probably the most exciting and long term advantage is that the Scottish government, higher education, and industry have combined forces to push their technical training facilities beyond the 20th century. Scotland already has a reputation for training excellent engineers, and its thoroughly modern approach to technical education incentives could soon make Scotland *the* country renowned for training microelectronics professionals.

Edinburgh University will celebrate its 400th anniversary in 1983. Wolfson Institute began in 1969 with a private endowment from the Wolfson Foundation; now it is a self-funded research and development organization excelling in MOS technology. The Institute will turn over £400,000 this year from supplying custom designs and prototype devices to such august customers as Motorola, General Instrument, Signetics, National, and Plessey.

The primary goal at Wolfson, however, is to provide an advanced wafer fabrication facility for the Electrical Engineering Department of Edinburgh. Armed with an impressive CAD facility on campus, students turn out IC designs, which are then committed to wafers by Wolfson engineers. Students later probe, debug, and test packaged versions of their own designs.

Certainly the combination of financial incentives and promises of the educational approach are major reasons why today one can find very large and modern IC manufacturing facilities already within Scotland's borders, or being erected by such well-known firms as General Instrument, National, NEC, Motorola, and Hughes Microelectronics. The Scottish Development Agency takes rightful pride in referring to the lowland stretch between Glasgow and Edinburgh as the *new* Silicon Valley.

Contrasting this with the typical collection of outdated hand-me-down donations from industry that can be found on many U.S. engineering campuses, and with recent cutbacks in government grants for education, is not a comforting thought. With the big guns of the semiconductor industry training on Scotland's Silicon Valley, it's not hard to imagine a day when Scottish microelectronics specialists and Scotland could lead the way in advanced semiconductor technology.

Saul B. Dinman
Editor in Chief

Best Technical Article of the Month—May
"A Designer's Review of Data Communications"
Alex Goldberger, Signetics Corporation

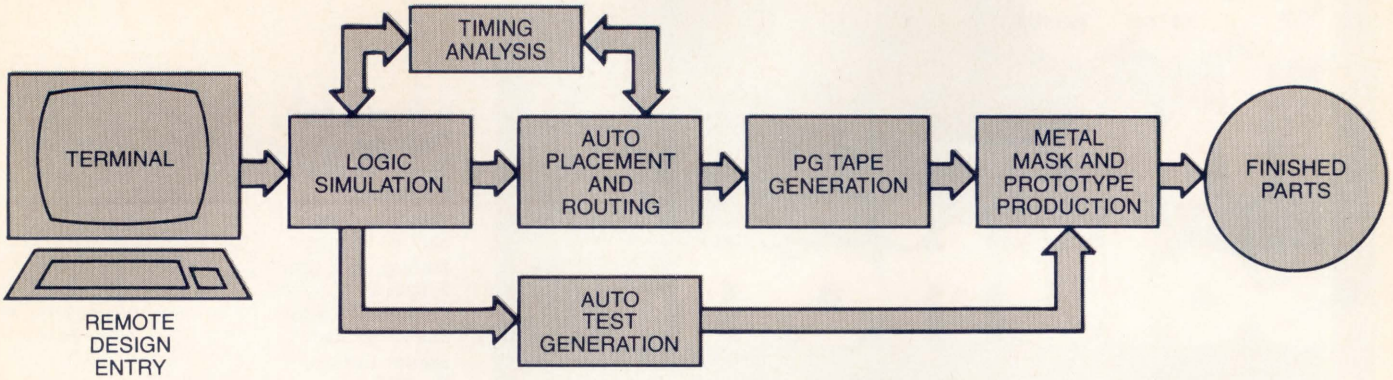
This article will now compete with other monthly winning articles for the 1981 Windjammer cruise award.

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FAMILY	GATE COMPLEXITY	METAL LEVELS	CHANNEL LENGTH	GATE SPEED	MAX PINS	LDS 1 SUPPORT
LC 3100	300-1780	1	6.0	10	92	YES
LSI 4000		1	3.5	8	96	YES
LSI 5000	800-6000	2	3.0	5	176	YES
LSI 7000*	1000-10000	2	2.0	2	200	YES

**LSI 7000 available for designs Q1, 1982.*

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LCA 1200	1200	2	0.9	68	YES

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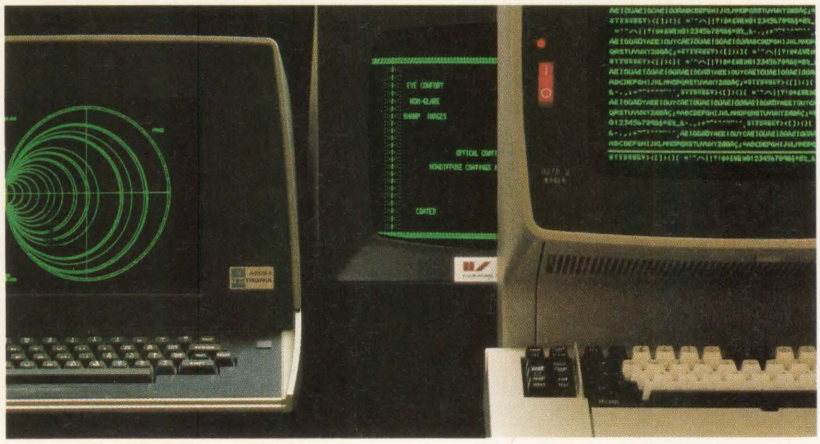
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CALENDAR

CONFERENCES

OCT 30-NOV 1—South Florida Computer Showcase Expo, Miami Expo/Ctr, Miami, Fla. INFORMATION: Peter B. Young, The Interface Group, 160 Speen St, Framingham, MA 01701. Tel: 617/879-4502; 800/225-4620 (outside Mass)

NOV 5, 12, AND 17—Invitational Computer Confs, Amsterdam, The Netherlands; Paris, France; and Milan, Italy. INFORMATION: B. J. Johnson & Assocs, Inc, 2503 Eastbluff Dr, Suite 203, Newport Beach, CA 92660. Tel: 714/644-6037

NOV 9-11—ACM '81 (Assoc for Computing Machinery Conf and Expo), Bonaventure Hotel, Los Angeles, Calif. INFORMATION: ACM '81 Conf Info, PO Box 24059, Village Station, Los Angeles, CA 90024

NOV 9-12—Autofact III Conf and Expo, Cobo Hall, Detroit, Mich. INFORMATION: Autofact III, SME Public Relations, One SME Dr, PO Box 930, Dearborn, MI 48128

NOV 9-12—Isratech '81, Binyanei Ha'ooma Conv Ctr, Jerusalem, Israel. INFORMATION: Joan Leavitt, Ruder & Finn, 1225 19th St NW, Suite 270, Washington, DC 20036. Tel: 202/466-7800

NOV 9-13—IECI '81 (Internat'l Conf and Exhibit on Industrial Control and Instrumentation Applications of Mini- and Microcomputers), Hyatt Regency Hotel, San Francisco, Calif. INFORMATION: LeRoy Bushart, FMC, 328 Brokaw Rd, Santa Clara, CA 95051. Tel: 408/289-3871

NOV 10-12—Interface West '81, Los Angeles Conv Ctr, Los Angeles, Calif. INFORMATION: The Interface Group, 160 Speen St, Framingham, MA 01701. Tel: 617/879-4502; 800/225-4620 (outside Mass)

NOV 10-12—MIDCON, O'Hare Expo Ctr and Hyatt Regency O'Hare Hotel, Chicago, Ill. INFORMATION: Robert Myers, Electronic Conventions Inc, 999 N Sepulveda Blvd, El Segundo, CA 90245. Tel: 213/772-2965

NOV 11-12—ECSG (Electronic Connector Study Group) Sym, Franklin Plaza, Philadelphia, Pa. INFORMATION: Jim Pletcher, Amp, Inc, Harrisburg, PA 17105. Tel: 717/780-8857

NOV 13-15—Los Angeles Computer Showcase Expo, Los Angeles Conv Ctr, Los Angeles, Calif. INFORMATION: Peter B. Young, The Interface Group, 160 Speen St, Framingham, MA 01701. Tel: 617/879-4502; 800/225-4620 (outside Mass)

NOV 16-19—CPEUG '81 (COMPUTER PERFORMANCE EVALUATION USERS GROUP), St Anthony Hotel, San Antonio, Tex. INFORMATION: Theodore F. Gonter, U.S. General Accounting Office, Rm 6011, 441 G St NW, Washington, DC 20548. Tel: 202/275-5040

NOV 17—Invitational Computer Conf, Hyatt Palo Alto, Palo Alto, Calif. INFORMATION: B. J. Johnson & Assocs, Inc, 2503 Eastbluff Dr, Suite 203, Newport Beach, CA 92660. Tel: 714/644-6037

NOV 19-22—COMDEX '81, Las Vegas Conv Ctr, Las Vegas, Nev. INFORMATION: The Interface Group, 160 Speen St, Framingham, MA 01701. Tel: 617/879-4502; 800/225-4620 (outside Mass)

DEC 7-9—Internat'l Electron Devices Meeting, Washington Hilton Hotel, Washington, DC. INFORMATION: Melissa Widerkehr, Courtesy Assocs, 1629 K St, NW, Washington, DC 20006. Tel: 202/296-8100

DEC 8—Computer Networking Sym/NBS, Gaithersburg, Md. INFORMATION: Robert Toense, B226, Technology Bldg, Nat'l Bureau of Standards, Washington, DC 20234. Tel: 301/921-3516

DEC 15-19—Gulf Computer Exhibition, Dubai Internat'l Trade Ctr, Dubai, U.A.E. INFORMATION: Seymour House, 17 Waterloo Pl, London SEIY 4AR, England. Tel: 01/930-3881; OR Trade Ctr Mgmt Co, PO Box 9292, Dubai, U.A.E., Tel: 472200

JAN 18-21—ATE Seminar/Exhibit, Pasadena Ctr, Pasadena, Calif. INFORMATION: Elaine Bull, Promotion Coordinator, ATE Seminar/Exhibit, 1050 Commonwealth Ave, Boston, MA 02215. Tel: 617/232-5470

JAN19-21—SOUTHCON, Orange County Conv Ctr, Orlando, Fla. INFORMATION: Dale Litherland, Electronic Conventions, Inc, 999 N Sepulveda Blvd, El Segundo, CA 90245. Tel: 213/772-2965

JAN 20-22—Texas Computer Show, Dallas Conv Ctr, Dallas, Tex. INFORMATION: Catherine Manor, Texas Computer Show, PO Box 214035, Dallas, TX 75221. Tel: 214/761-9108

FEB 10-12—Internat'l Solid State Circuits Conf, Hilton Hotel, San Francisco, Calif. INFORMATION: L. Winner, 301 Almeria Ave, Coral Gables, FL 33134. Tel: 305/446-8193

FEB 20-26—COMPCON Spring, Jack Tar Hotel, San Francisco, Calif. INFORMATION: Harry Hayman, PO Box 639, Silver Spring, MD 20901. Tel: 301/589-3386

SEMINARS

NOV 2-5, DEC 1-4, AND JAN 19-22—Data Base Technology, Chicago, Ill; Washington, DC; and San Francisco, Calif. INFORMATION: Digital Equipment Corp, Educational Services, Seminar Programs, 12 Crosby Dr, BU/E58, Bedford, MA 01730. Tel: 617/276-4949

NOV 9-13—Making Silicon Talk ... and Listen, Santa Barbara, Calif. INFORMATION: A. H. (Steen) Gray, Jr, Signal Technology, Inc, 15 W De La Guerra, Santa Barbara, CA 93101. Tel: 805/963-1552; 800/235-5787 (outside Calif)

NOV 22-25—Microcomputers in Education, Cambridge, Mass. INFORMATION: TERC, 8 Eliot St, Cambridge, MA 02138. Tel: 617/547-3890

DEC 14-16—Introduction to Micro/Personal Computers: Application, Selection and Usage Guidelines, Chicago, Ill. INFORMATION: Datapro Research Corp, 1805 Underwood Blvd, Delran, NJ. Tel: 609/764-0100; 800/257-9406 (outside NJ)

NOV-DEC—Data Communications for Minicomputer Users, various U.S. cities. INFORMATION: For dates and locations, contact Seminar Administrator, Micom Systems, Inc, 20151 Nordhoff Ave, Chatsworth, CA 91311. Tel: 213/882-6890

SHORT COURSES

NOV 4-6—Management of CAD/CAM, Los Angeles, Calif. INFORMATION: Marc Rosenberg, UCLA Extension Short Course Program Office, 6266 Boelter Hall, UCLA, Los Angeles, CA 90024. Tel: 213/825-1047

NOV 16-20—Introduction to FORTH Programming Language, Belmont, Calif. INFORMATION: Inner Access Corp, 517 Marine View Suite K, Belmont, CA 94002. Tel: 415/591-8295

DEC 7-9, JAN 18-20, FEB 1-3, FEB 17-19, AND MAR 15-17—Writing for Results: A Course for Computer Professionals, San Francisco, Calif; Atlanta, Ga; Phoenix, Ariz; New York, NY; and Boston, Mass. INFORMATION: American Management Assocs, 135 W 50th St, New York, NY 10020. Tel: 212/586-8100

DEC 14-16—Software Design for Data Communications Systems, George Washington U, Washington, DC. INFORMATION: Director, Continuing Engineering Education, George Washington U, Washington, DC 20052. Tel: 202/676-6106

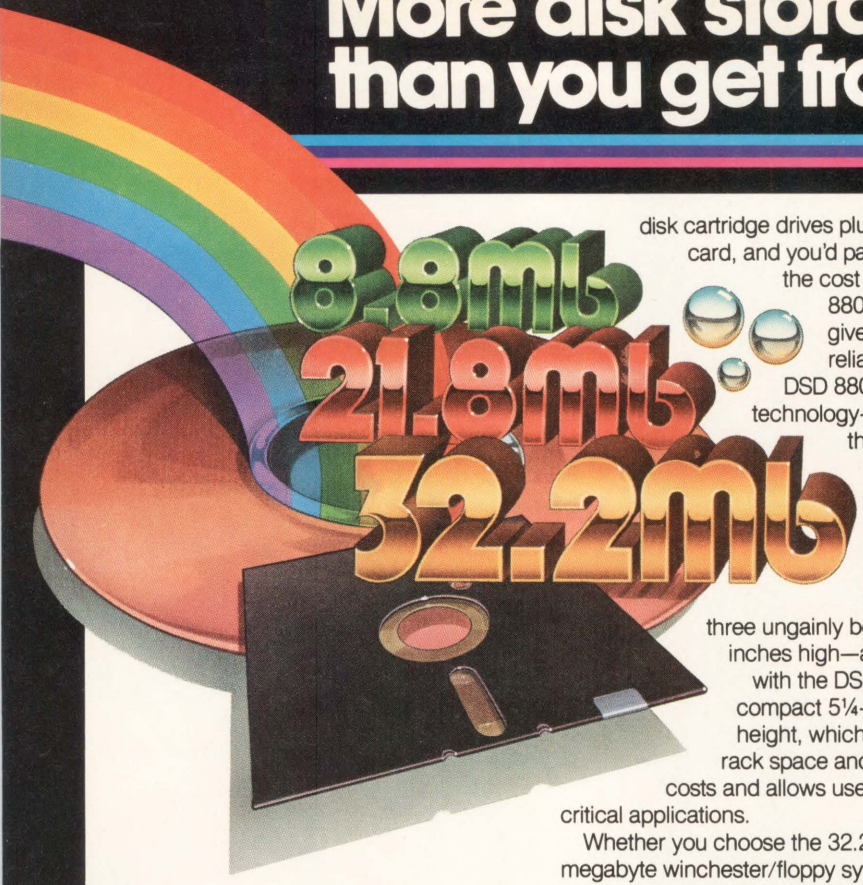


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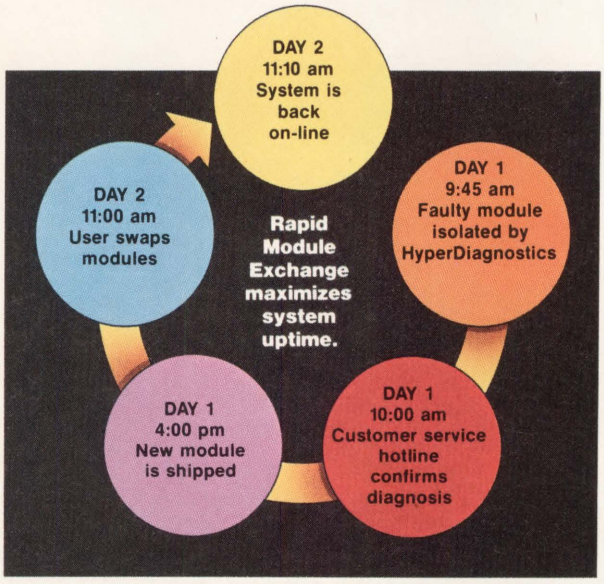
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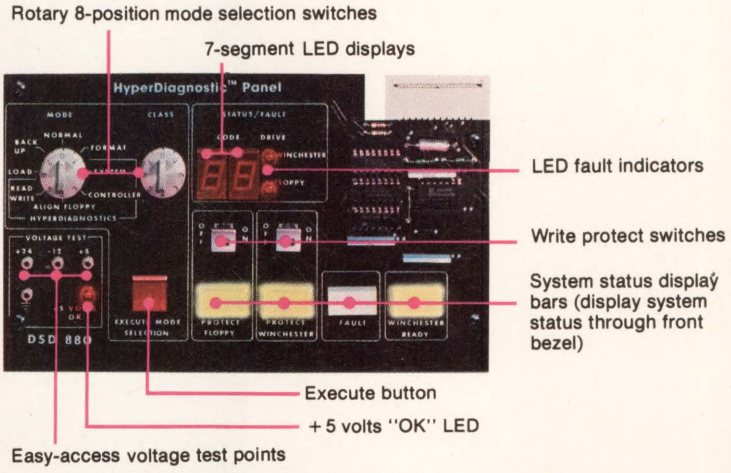
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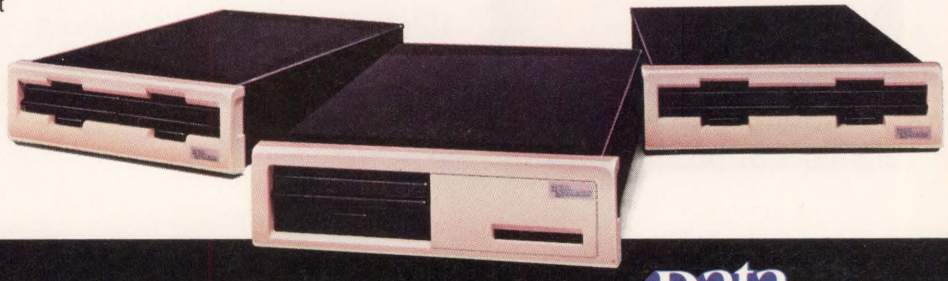
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*This controller/interface is also available separately as the DSD 4140.

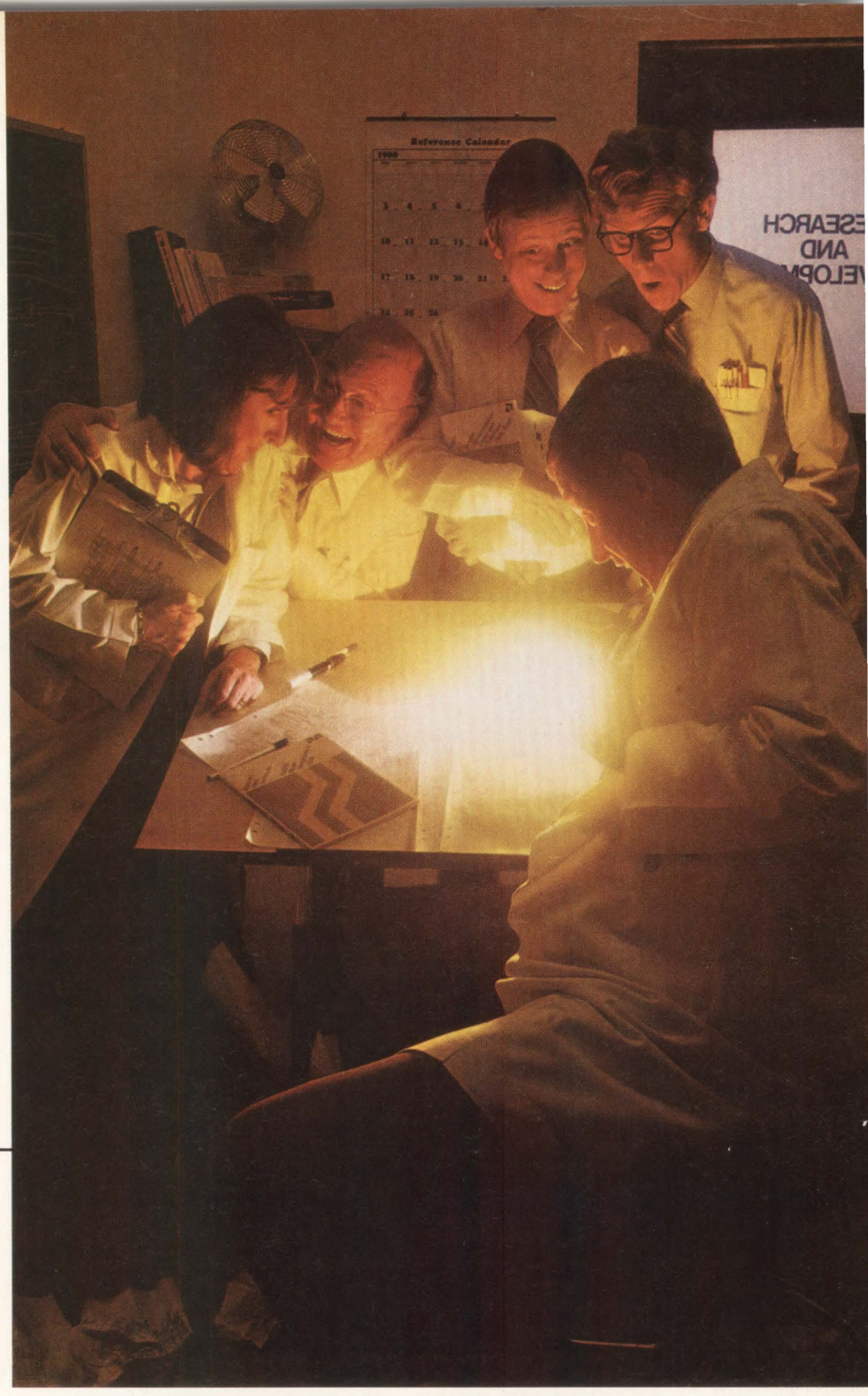
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Circle 101 for DSD 880 information.
Circle 102 for DSD 480 information.
Circle 103 for DSD 470 information.
Circle 104 for DSD 440 information.
Circle 105 for DSD 430 information.



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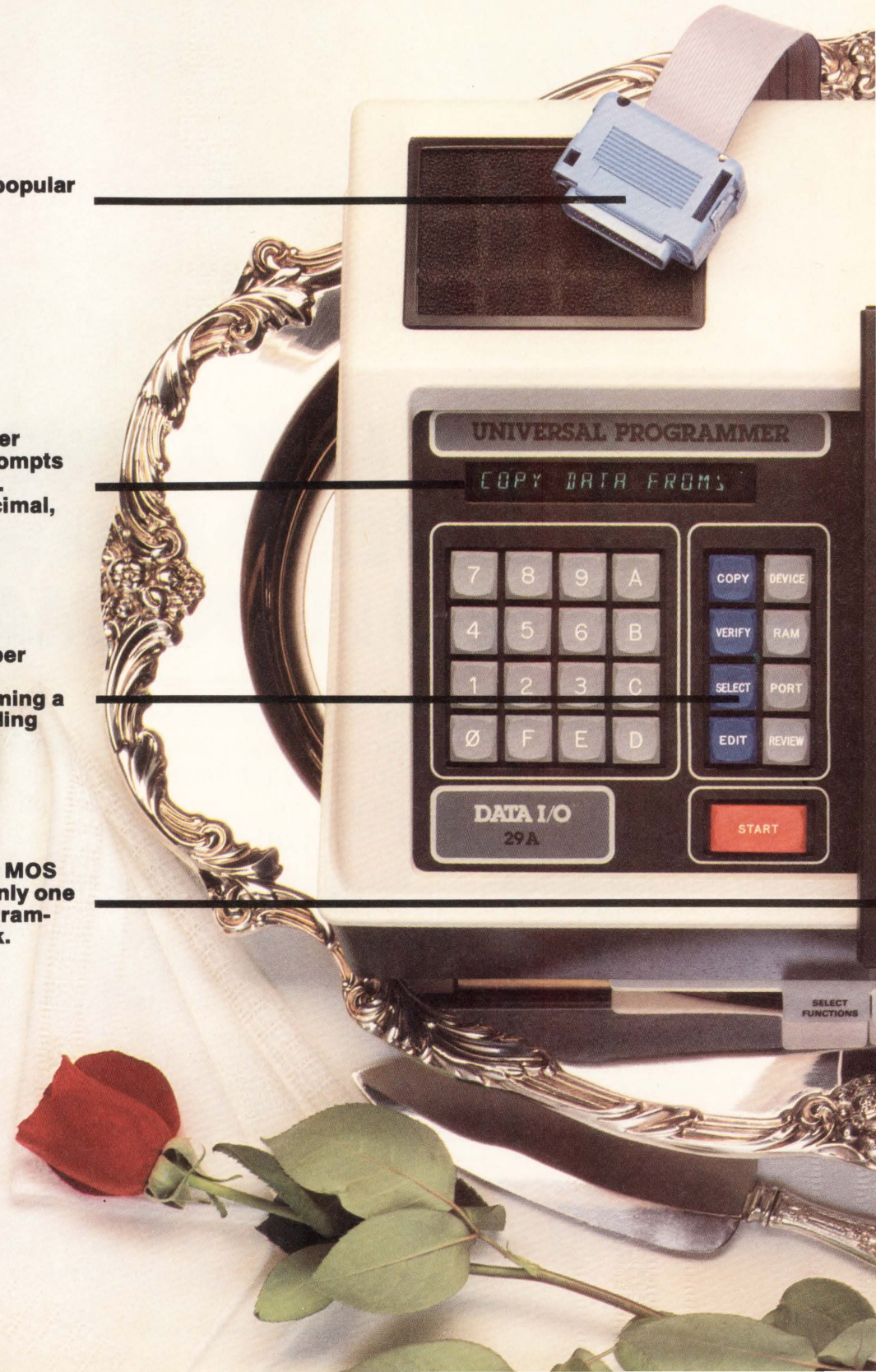
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Like our unique System 19, the 29A is designed around a standard mainframe and plug-in modules. The same plug-in modules may be used in both units.

With the 29A and one UniPak module, you can program more than 250 MOS and bipolar PROMs. You'll have complete first and second source capabilities from AMD, Fairchild, Harris, Intel, MMI, Motorola, National, Raytheon, Signetics and TI. As device capacities grow, 29A's RAM grows to meet the need. The standard unit comes with an 8K x 8 RAM which can be expanded to 32K x 8.

The 29A is simple and straightforward to operate. It uses a logical, easy-to-remember sequence of keystrokes for programming. A 16-character alphanumeric display prompts the operator in plain English and provides error information to help eliminate the need for cross references. The keys are large and easy to read.

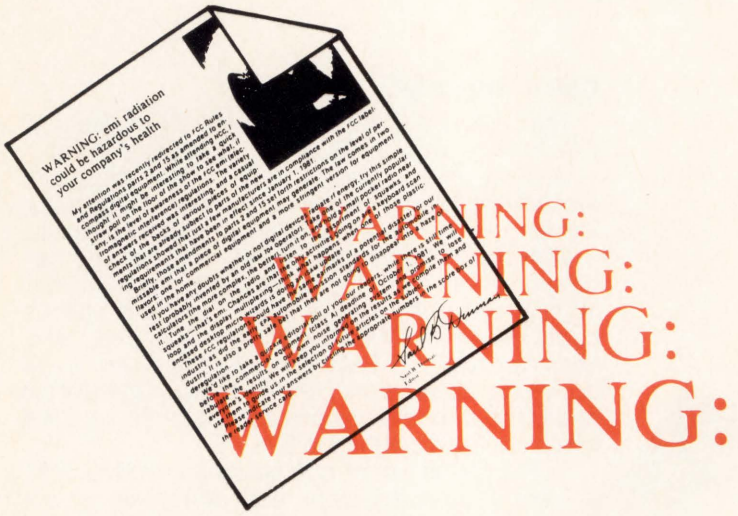
Anyone who uses a development system will appreciate how easy it is to interface with the 29A directly through the standard RS232C port. The 29A has ten development system formats included in its more than 25 communication formats. Formats to support eight and 16 bit development systems from Motorola, Intel, Tektronix, and Hewlett-Packard are all standard. If you own a Motorola or Intel unit, you can program PROMs directly from the development system keyboard. We've also included remote control as a standard feature.

If you would like to know more, please circle the reader service number. For immediate action, contact Data I/O, P.O. Box 308, Issaquah, WA 98027. Phone 206/455-3990. Europe: Vondelstraat 50-52 1054 GE, Amsterdam, The Netherlands, tele: (20) 186855. Japan: Sankei Building 1-8, Saraguka-cho, 2-chome, Chiyoda-ku Tokyo 101, Japan, Tel: (03) 295-2656.

DATA I/O

THE NEW 29A PROM AND LOGIC PROGRAMMER

CIRCLE 12 ON INQUIRY CARD



To the Editor:

I was pleased to see the *Computer Design* editorial and questionnaire on the newly adopted FCC emi requirements in your June 1981 issue. As a full-time consultant in the commercial emi field, I have also found that far too few EDP equipment manufacturers recognize the problem the FCC has been having with EDP equipment, or the extent to which the new regulations can affect existing and future designs. My own informal surveys show that EDP equipment manufacturers generally respond in one of two ways when confronted with the new FCC regulations.

The first type of response can most accurately be described as "What I don't know won't hurt me." Typical responses are "we can't keep track of all governmental regulations"; "we're not going to worry about it until it becomes a problem (to us)"; or "the FCC doesn't have the manpower to check up on everyone, so we're going to take our chances." When informed of the interim labeling requirements, one vice president told me that since his company did not receive a notification from the FCC it was going to assume that labels were not required. (I wish I could use the same argument with the IRS!) Many of these manufacturers do not realize that failure to comply with the FCC regulations can be both a civil and criminal offense and that conviction can result in fines, impounding of noncompliant equipment, recalls, and, in extreme cases, jail terms for the officers of the company.

The second type of response, and by far the most common, is sheer panic. EDP manufacturers will equate "emi" with "military" and start applying costly emi shielding and filtering concepts to existing products, or, even worse, start incorporating every emi fix that is advertised or recommended. They will specify the wrong type of emi filters, improperly specify and apply conductive coatings that do not provide enough shielding, and insist on buying power supplies that are "designed to meet the FCC conducted emissions requirements," even though the FCC specifically exempts power supply subassemblies from compliance. You would be surprised at how often an emi filter is selected on the basis of size and voltage programming capability rather than its emi suppression capabilities, or how often an FCC compliant power supply is specified in the belief that it will automatically guarantee the compliance of the entire system as well.

Under these conditions, I often find myself caught between an engineering department that wants to build an EDP product that would make the military and the manufacturers of emi suppression materials proud and a marketing department that is horrified by the thought of trying to convince a potential customer that this "ugly" product will look just fine with his new office decor. FCC compliance should not be cause for panic. If handled with the same care as any other design parameter, it can be incorporated into a system with a minimum of impact on cost and appearance.

Franz Gisin
Gisin Consultants Inc
Campbell, Calif

To the Editor:

Your concern about the new FCC regulations on emi in the June 1981 issue is understandable in light of the overkill on pollution regulations in other areas. There is, however, the other side of the issue.

The same stuff that gets out can get in and degrade digital equipment performance. There are amateur radio operators wrapping their well-known home computers in grounded aluminum foil to keep their radio teletype programs from crashing.

I had a frequency counter that generated enough noise to make it almost impossible for it to calibrate its own time base oscillator with the National Bureau of Standards Radio WWV.

The new plastic housing keeps the dust out but the emi neither in nor out.

Robert Ziller
Doboy Packaging Machinery
New Richmond, Wis

8" Cartridge Drive Shopping Guide

	IOMEGA Alpha-10	CDC Lark	DP100 Lynx
User Available Capacity			
M Bytes per Cartridge	✓10	6.7	✓10
M Bytes per Fixed Disk	0	✓6.7	0
Bytes per Track	✓32,768	16,384	12,288
Spare Capacity, K Bytes per Drive	✓447	98	123
Average Positioning Time, MS	✓35	50	60
Data Transfer Rate, M Bytes per Sec.	✓1.1	✓1.2	0.9
MTBF, Hours	✓8,000	6,000	6,000
Reliability,			
Soft Read Errors	10^{10}	10^{10}	10^{10}
Non-Recoverable Errors	10^{12}	10^{12}	10^{12}
Power, Watts	✓35*	100	100
Dimensionally Compatible with Diskette Drive (SA 801R)	✓YES*	NO	✓YES
Start / Stop Time, Sec.	✓2/5	120/60	90/30
Cartridge Price	✓$37.50	$89	$83

*Drive and LSI Controller

Evaluate the Alpha-10.

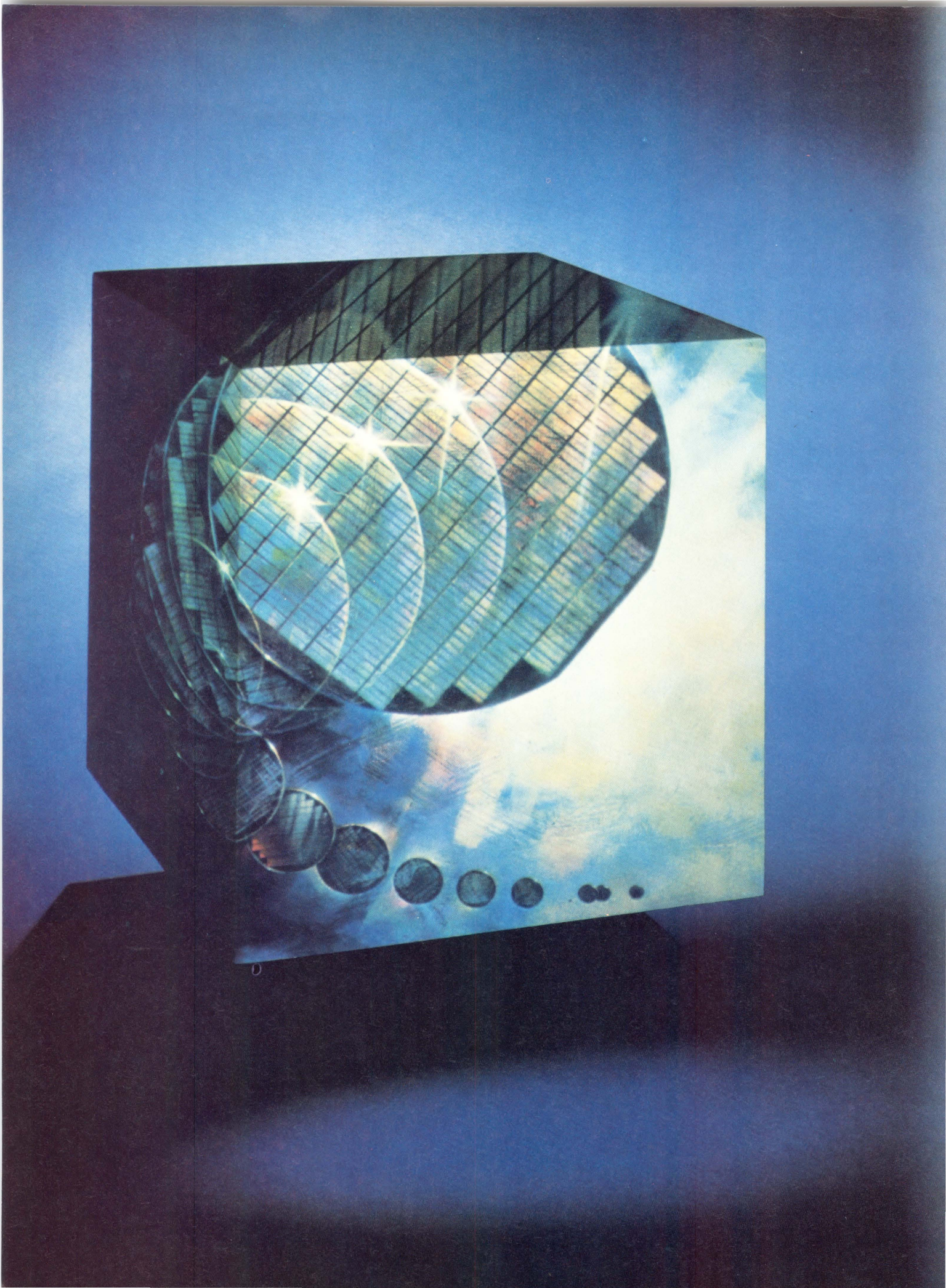
Compare the specifications of any 8" cartridge drive and then evaluate the IOMEGA Alpha-10. The Alpha-10 gives you 10 megabytes of user available data in each cartridge. As you can see, the Alpha-10 has the lowest priced cartridge — less than half the competition — and it easily out-performs the other 8" cartridge drives.

To order your evaluation unit, call IOMEGA at (801) 392-7581. You'll see for yourself that the future belongs to IOMEGA's Bernoulli Technology.



IOMEGA 4646 South 1500 West / Ogden, Utah 84403 / (801) 392-7581

CIRCLE 13 ON INQUIRY CARD



Another new standard from INMOS.

4K x 4/16K Static RAM

The IMS1420: High Speed. Low Power. Available Now.

The VLSI technology leader in 16K static RAMs introduces another industry first. Organized 4K x 4, the IMS1420 offers a chip enable access time as fast as 45ns.

Lowers System Cost

The low entry level price of $38.00 (100's) for the IMS1420-55 makes this new 4K x 4 a viable alternative to 4K x 1 and 1K x 4 fast static RAMs. It matches their speed, saves board space and reduces power consumption by at least a factor of four. Trade off your 4K designs today and lower your system costs.

Need Higher Speed?

The companion IMS1421 delivers even more performance where higher speed is a must. With a chip select access time as fast as 30ns, the IMS1421 sets a new speed record for 16K memories.

Naturally, both new RAMs operate from a single +5V (±10%) supply and are fully TTL compatible. They're packaged in industry standard 20-pin, 300-mil dips and also industry standard 20-pin chip carriers.

Application Note Tells You How

Check your current 4K static RAM designs today. Chances are good that one of the new INMOS 4K x 4 RAMS offers a better system solution. Call or write for our new application note that tells you how to make the switch - and save.

INMOS 16K STATIC RAMS					
Static RAM Family	Organization	Max. Access Time		Max. Power Dissipation	
		Chip Enable/Select	Address	Active	Standby
IMS1420-45	4K x 4	45ns	40ns	600mW	110mW
IMS1420-55	4K x 4	55ns	50ns	600mW	110mW
IMS1421-40	4K x 4	30ns	40ns	600mW	NA
IMS1421-50	4K x 4	40ns	50ns	600mW	NA
IMS1400-45	16K x 1	45ns	40ns	660mW	110mW
IMS1400-55	16K x 1	55ns	50ns	660mW	110mW

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CIRCLE 14 ON INQUIRY CARD



BUILD

YOUR OWN 68000 SYSTEM THE EASY WAY

FULLY ASSEMBLED BOARDS PROVIDE COMPLETE 68000 CAPABILITY. AND ALL BOARDS CAN BE INTEGRATED INTO YOUR OWN SYSTEM.

MC68000 MULTIBUS™ BASED MICROCOMPUTER

This board provides a full speed MC68000 as the CPU for your Multibus™ based system. 256 kilobytes of on-board RAM permit the MC68000 to execute code at full speed (8-MHz clock with no wait states). The board is compatible with the proposed IEEE P796 bus at a compliance level of D16M20I16V02L. Edge connectors for a logic analyzer are provided to ease debugging. Bus timeout protection, simple memory protection and interrupt type selection are also provided.

MAIN PERIPHERAL BOARD
- Up to 32K Bytes of PROM
- Triple Interval Timer
- Two Programmable USARTS
- Polynomial Generator and Checker
- Three Parallel Interface Chips
- Keyboard Interface
- Baud Rate Generator for USARTS
- Priority Interrupt Controller

VIDEO BOARD
- 32K Bytes of RAM
- Programmable Video Controller
- Programmable DMA Controller
- PROM Character Sets—Up to 256 Characters
- Enhancements: Reverse Video, Understrike, Intensify, Blink, Suppress
- Interrupt Level Options

An I/O board with up to 5 serial I/O ports is also available; other Multibus™ compatible boards will be available in the near future.

Multibus is a trademark of Intel Corporation.

For further information, write or call:

TSD Display Products, Inc. 35 Orville Drive, Bohemia, New York 11716. Tel. 516-589-6800

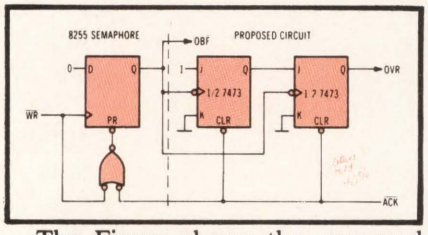
TSD

LETTERS TO THE EDITOR

To the Editor:

I have read Peter Rony's article (Mar 1981, pp 150-152) and have found an application that can justify the difference between a 7474 D-type flipflop and 8255 semaphores.

As the author explains, the behavior of 8255 semaphores is illustrated in Fig 3, which corresponds to the timing diagram in Fig 2(a). In Fig 3, the Q output ($\overline{OBF}$) goes high and low when a second clock pulse ($\overline{WR}$) appears. With the aid of a 7473 J-K flipflop connected as a 2-bit negative edge-triggered shift register, this will allow an overrun (OVR) flag to be implemented. This flag will be set when a new word is written into the 8255 port before the preceding word has been read; ie, the overrun flag will be set if two consecutive write pulses appear and no acknowledge ($\overline{ACK}$) is generated between them.



The Figure shows the proposed circuit. Note that the only restriction is that the microprocessor must check the OVR flag before asserting $\overline{ACK}$.

Alejandro M. Pasika
Buenos Aires, Argentina

The Author Replies:

A microcomputer interfaced to the 8255 chip can check for an $\overline{ACK}$ signal after the microcomputer sends a $\overline{WR}$ signal: test the $\overline{OBF}$ semaphore for a logic 1 state. Thus, in a correctly written program, the situation that Mr Pasika proposes should not exist. I do not believe that the designers of the 8255 had his application in mind when they decided upon the characteristics of the 8255 semaphores.

Peter R. Rony
Virginia Polytechnic Institute
and State University
Blacksburg, Va

CIRCLE 15 ON INQUIRY CARD

Do You Need MIL Reliability In A Cartridge Disk Drive? But Can't Stand The Cost?

THEN LOOK TO THE VRC® 5017-4

The VRC 5017-4 Cartridge Disk Drive is designed to meet the severe demands of extremely harsh environments and mobile operations that prove too tough for commercial devices, but do not justify the expense of a full Mil. Spec. unit. In fact, you can realize up to a 75% savings when compared to the cost of a full Mil. Spec. device.

The formatted capacity of 52 megabytes is contained on one fixed disk and one removable cartridge, each storing 26 Mbytes of data. This configuration allows the creation of backup files for off-line storage using a single drive.

Every data track contains interspersed pre-recorded servo information which is read by the data head and fed back to the voice coil positioner, forming a closed-loop servo system. This feature enhances reliable cartridge exchange, a wide operating temperature range and practically eliminates seek errors.

High shock and vibration tolerance, a closed-loop air filtration system, an automatic actuator lock, special mounting brackets and cartridge clamps make the unit ideal for mobile installations.

For more information, call or write: Vermont Research Corporation, Precision Park, North Springfield, Vermont 05150 (802) 886-2256. TWX 710-363-6533.

- Interspersed Servo System
- MTBF 5,000 Hours
- Formatted Capacity 52 Megabytes



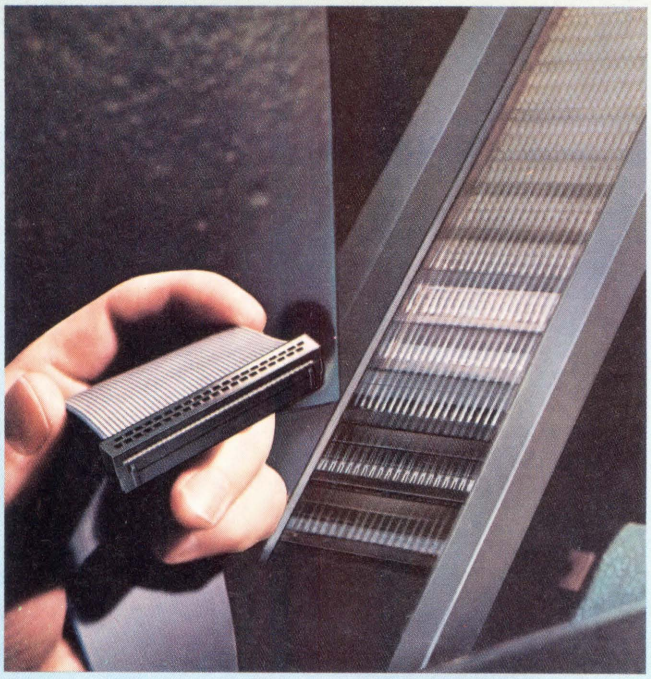
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Building Products That Build Reputations.

CIRCLE 16 ON INQUIRY CARD

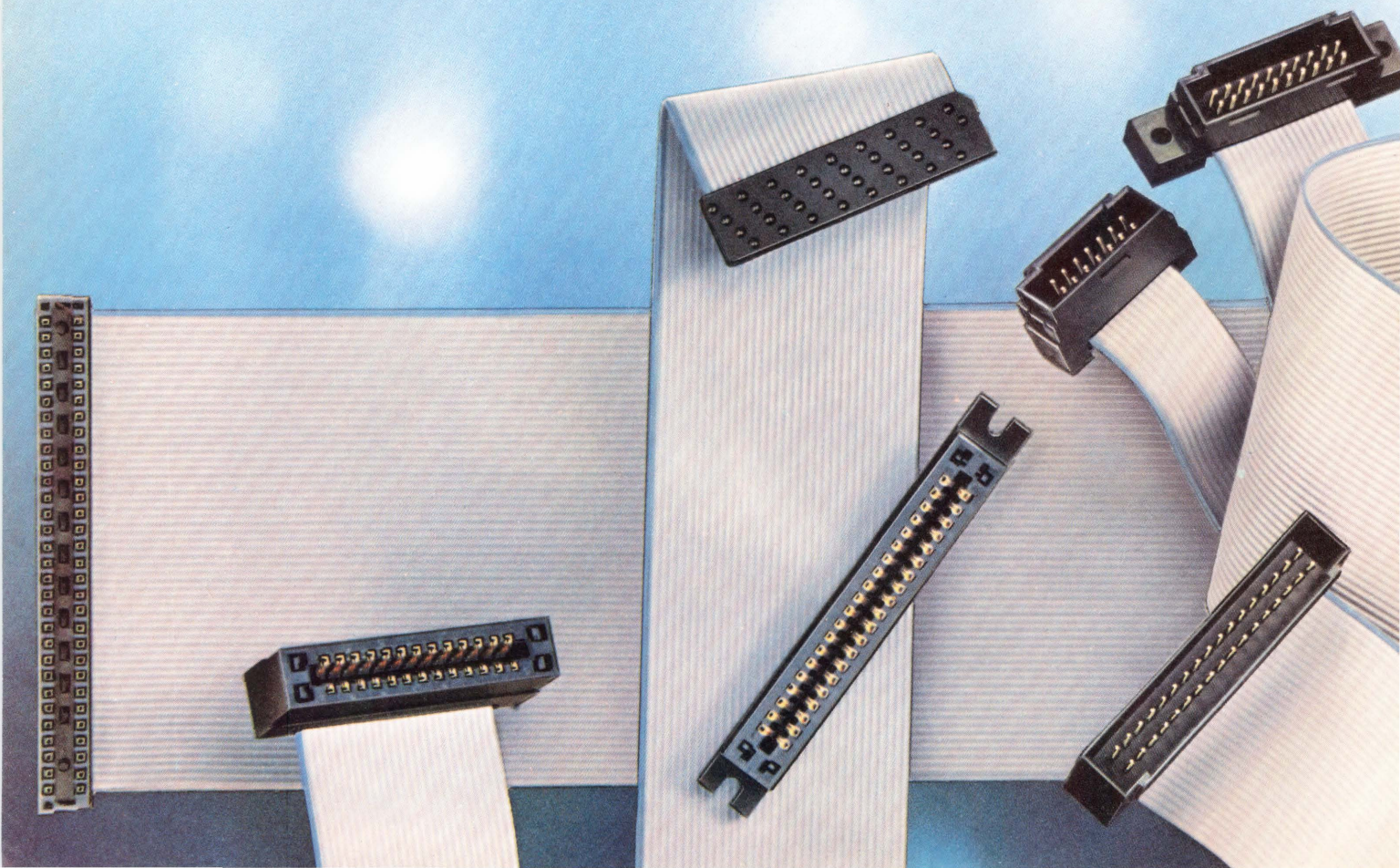
Double your production rate of ribbon cable assemblies.



Now you can terminate AMP Latch connectors at the rate of 450 an hour. That's more than double the speed of what you can do with other ribbon cable connectors.

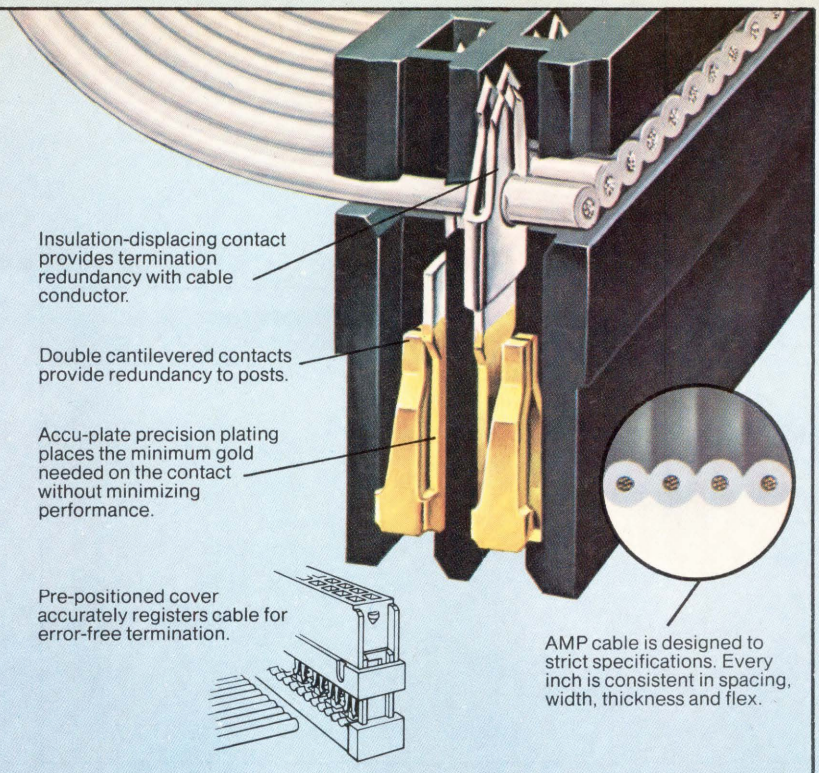
Our new semi-automatic tool makes it happen. It precision feeds, positions and terminates preassembled receptacle connectors in one step. Our precision cable further minimizes rejects, because it's designed and manufactured to strict dimensional specs. And our complete range of fully shrouded headers includes a positive locking type you can squeeze-to-release with one hand.

With these continued advancements and our wide mix of connectors, the AMP Latch system is more productive than ever.



AMP Facts

Wire Types: Small-gauge solid or stranded discrete, plus flat ribbon, woven ribbon and other types of flat cable with round conductors on .050" centers.
Size: 10 through 60 positions.
Connector Types: Wide variety of cable-to-cable, card edge, DIP and receptacle connectors available.
Electrical Current Rating: 1 ampere (continuous).
Operating Temperature Range: −55°C to +105°C
Dielectric Withstanding Voltage: 500 volts RMS.
Tooling: Pneumatic, manual and semi-automatic bench termination machines.

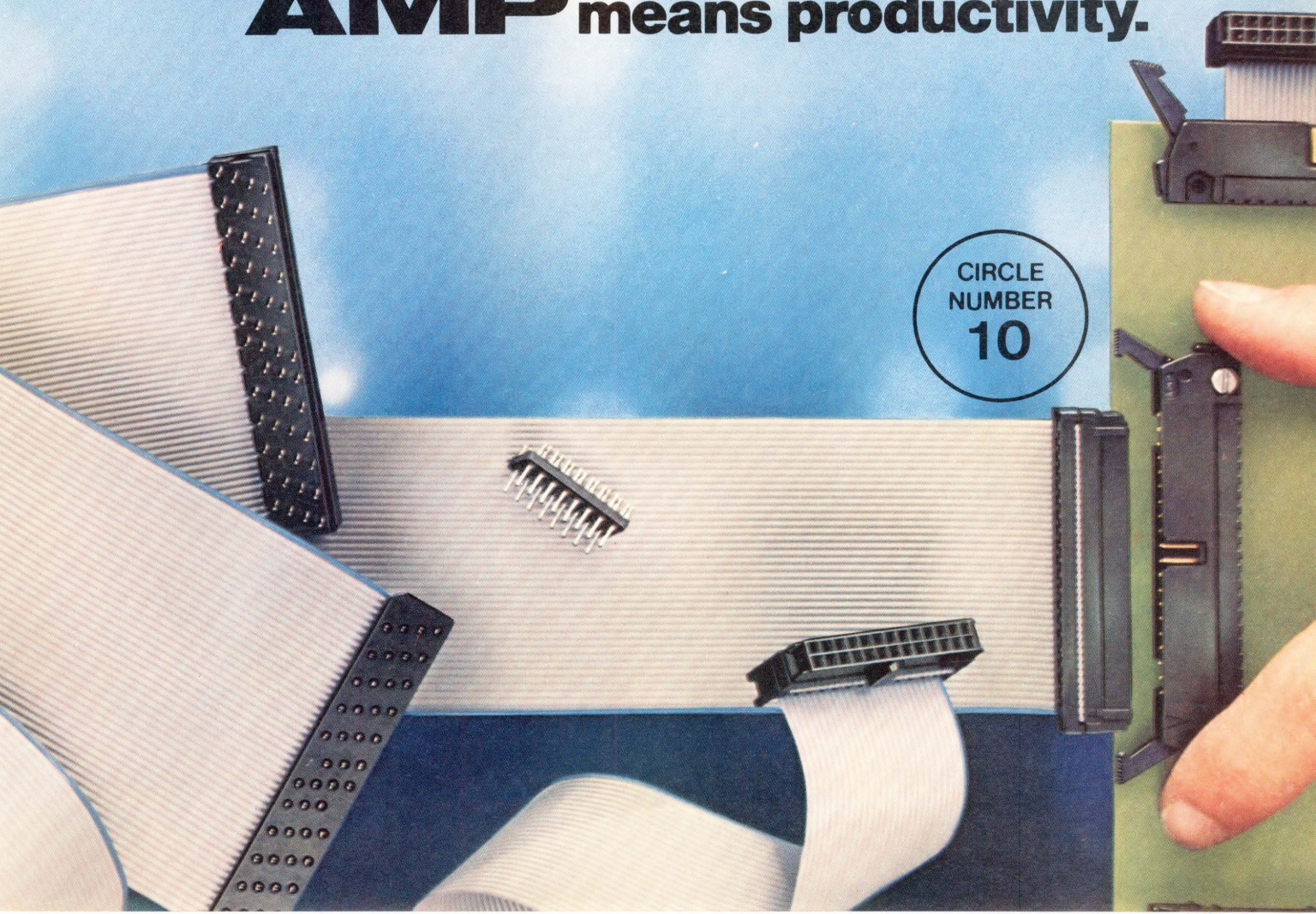


For a free sample, call the AMP Latch Information Desk at (717) 780-8400.

AMP Incorporated, Harrisburg, PA 17105

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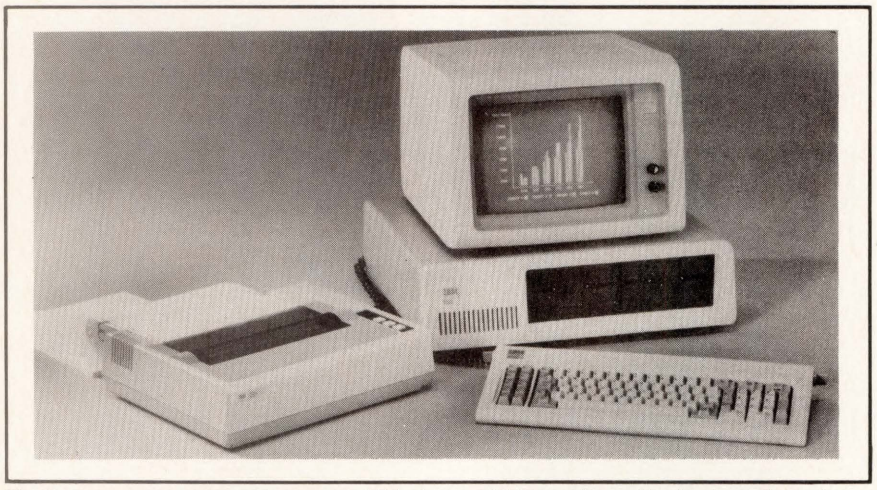
AMP means productivity.



CIRCLE NUMBER 10

MICROPROCESSORS/ MICROCOMPUTERS

Personal computer based on 16-bit CPU supplies power and potential



Featuring memory capacity up to 256k bytes, 83-key adjustable keyboard, and color graphics capabilities, IBM's smallest, lowest priced computer can connect to standard color or black/white TV set. With optional 80-char/s printer, high resolution monochrome display, and two diskette drives, as shown, the system sells for $4385

Aiming to become a volume producer in a market already dominated by three major suppliers, IBM has departed from its "invented here" tradition and past marketing techniques. Its contender, the IBM Personal Computer, mixes an Intel 8088 CPU with IBM hardware and peripherals manufactured for IBM and runs not only an IBM operating system but also CP/M-86 and UCSD p-code systems.

Developed at IBM's Information Systems Div, Entry Systems Business, PO Box 1328, Boca Raton, FL 33432, the machines are available through Computerland and Sears, Roebuck and Co business machines stores, as well as IBM product centers. A basic system with attached audio cassette recorder and TV set for home use will sell for approximately $1565. A more typical system with 64k memory, single diskette drive, and its own display will cost about $3005, and an expanded system with business graphics, two diskette drives, and printer will run around $4500.

Standard hardware

Built using Intel's 16-bit 8088 chip as the CPU, the machine supplies about four times the processing power of its rivals. The chip's 16-bit internal architecture enables 8- or 16-bit data to be processed in single, string, or block form. Operating at 5 MHz, the processor can handle 8-bit multiplies in 15 μs. Arithmetic and alphanumeric capabilities allow programs to be written with fewer instructions and to run faster than on 8-bit machines.

The basic machine consists of a system unit and detached keyboard. The system unit supplies 16k bytes of user RAM and 40k bytes of ROM containing a BASIC language interpreter and power up diagnostics. Also standard are a jack for attachment of an audio cassette and a speaker for musical programming. To the unit, users can attach a standard TV monitor or TV set with rf modulator. Connecting to the system unit through a 6′ (1.8-m) coiled cable, the keyboard contains 83 automatic repeat keys. Of these, 10 are reserved for numeric entry and cursor control, and 10 for special functions such as scrolling and editing.

Optional add-ons

To this basic system, users can add, by plugging option adapters into five expansion slots in the chassis, color or monochrome display, multiple printers, and one or two 5.25″ (13.34-cm) diskette drives that mount in the system unit. User memory expands from 16k- to 256k-bytes capacity with the addition of 16k-, 32k-, or 64k-byte memory modules. An RS-232-C asynchronous communications adapter establishes a link with data bases, other computers, or laboratory instruments.

The bidirectional 80-char/s printer, a $755 option, provides 40-, 66-, 80-, or 132-char/line formats. The unit supplies 12 type styles designed using a 9 x 9 matrix for legibility, and page spacing and column skip for word processing applications. The high resolution 11.5″ (29.2-cm) monochrome display, offered for $345, displays up to 25 lines of 80 characters. Powered by the system unit, the screen has 720 H x 350 V resolution, and offers underlining, high intensity blinking characters, and reverse image, as well as a nondisplay function for sensitive data. A $300 color/graphics monitor adapter permits displays of up to 16 colors for text and 8 colors for graphics (2 sets of 4 colors each) on standard video monitor or TV with rf modulator.

Using the asynchronous communications adapter ($150), the system can connect to a Series/1, host computer, another personal computer, or laboratory instrument. With a modem, it is possible to access the Dow Jones News/Retrieval Service, and the Source, an information and communications service providing news, airline schedules, restaurant guides, and stock prices. IBM plans to provide a full subset of 3270 emulation capability to enhance communications with larger systems.

Operating systems and program packages

The enhanced version of Microsoft BASIC provided with the basic package is extended further with diskette and advanced level offerings. The diskette extension supports use of diskettes and adds date, time of day, and communications. The advanced level provides display graphics features such as point, circle, and get/put display, as well as increased light pen and joy stick support for design and games. The disc operating system (DOS) package supports one or more diskette drives, and a Pascal compiler allows separate compilation of program elements for maximum system performance. In addition to the advanced disc operating system, adapted for the computer in conjunction with Microsoft, which supports software development and systems programs, CP/M-86 and UCSD P-System packages, adapted by Digital Research and SofTech Microsystems, allow applications software written for other machines to be transported to the system.

Among the applications packages that are available for home and office are VisiCalc (Personal Software), EasyWriter (Information Unlimited Software), and the MicroSoft Adventure game. General Ledger, Accounts Receivable, and Accounts Payable (Peachtree Software) packages are also provided for use on the system.

—Peg Killmon, Senior Editor

Circle 241 on Inquiry Card

Boost your profits with NEC printers.

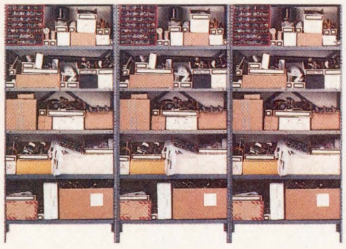


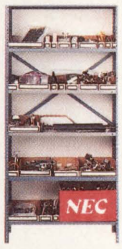
NEC

NEC Information Systems, Inc.

They're less expensive going in, and that's only the beginning.

Our printers also give you extra margins which no competitive printers can match. Here's how.





NEC printers have up to 50% fewer parts than competitive printers, so you stock fewer spares.

Built-in quality bolsters profits.

Spinwriter™ letter-quality printers have a mean time between failure (MTBF) of up to 3000 hours (that's about 18 months of normal operation), nearly twice the industry average. We've simplified their design and reduced parts counts by 60%. Result: fewer parts, less costly parts, better odds that the part you need is the part you have. Not to mention lower repair costs and administrative overhead.



Spinwriter printers, with an MTBF of up to 3000 hours, reduce your servicemen's labor and travel costs, administrative overhead and parts costs.

NEC printers have a mean time to repair (MTTR) as low as 20 minutes against an industry average of one hour. Meaning: your service force can become three times as productive.

Next, Spinwriter printers have a dead on arrival (DOA) rate of less than 1%, significantly better than the 5% other manufacturers consider acceptable. So with NEC, you can dock merge with confidence and eliminate the horrendous time and costs of incoming inspections.

All of which translates to the kind of value you take to the bank.

Spinwriter and Trimliner™ models galore

We've got 14 different Spinwriter models, at speeds up to 55 cps with Qume, Diablo, Centronics, or RS-232C interfaces. All use functional, easy-to-service single-board electronics, a one-piece universal power supply, and digital controls that eliminate many moving parts. Plus 10 forms handlers designed and built by NEC.

Our Trimliner line printers print up to 600 LPM. They have a 30-minute MTTR, the industry's best. A 50% better MTBF than competitive models. And a variety of quietized packages.



Because our Spinwriter printers have an MTTR as low as 20 minutes, one-third as long as others, your servicemen can average three times as many repairs per hour.

Take the first step to improving your profits.

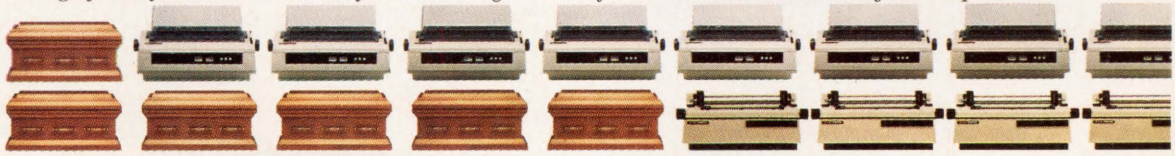
Send for information on NEC printers, or call your nearest NECIS sales office.

NEC Information Systems, Inc.
5 Militia Drive Lexington, MA 02173

Our significantly better DOA rate lets you dock merge with confidence and save hundreds of dollars per unit.

NEC DOA rate: less than 1%.

Other printers' DOA rate: more than 5%.



CIRCLE 17 ON INQUIRY CARD

Information. Yours for the asking. A complete library of technical information to keep you current with electronics wire and cable.

This represents state-of-the-art solutions to everyday wire and cable problems. And they represent the state-of-the-art wire and cable company, Brand-Rex.

Brand-Rex is the largest and most diversified wire and cable supplier to the computer, peripheral equipment, commercial, military and business machine markets. Brand-Rex developed proprietary products that are now standard problem solvers for the electronics world... in a wide range of wire and cable types and constructions. We provide our customers a single "one-stop" supply source. And give design engineers one product line that achieves maximum performance without compromising physical, thermal or electrical requirements.

Brand-Rex meets the toughest standards in the industry. All products are UL-listed. Many have joint UL, CSA recognition and are "OSHA acceptable." And they are MIL-Spec.

Wire and cable problems. We've got the solutions all wrapped up and waiting for you. In these state-of-the-art brochures. Fill in the coupon, and we will send you the ones you need ...free.

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ELECTRONIC AND INDUSTRIAL CABLE DIVISION

Brand-Rex Company Divisions
Abbott & Co.: electrical harnesses for industry
Brand-Rex Ltd. (Scotland): wire and cable
Electronic & Industrial Cable Division: wire and cable
Garry: electronic interconnections
General Circuits, Inc.: printed circuits
Nonotuck Manufacturing Company: copper wire
Pyle-National Company: electrical connectors
Telecommunications Division: wire and cable
Teltronics, Inc.: telecommunications products

BRAND-REX COMPANY, A PART OF AKZONA INC.

WIRE AND CABLE. ELECTRONICS WORLD.



STATE-OF-THE-ART-SOLUTIONS. FREE.

CIRCLE 18 ON INQUIRY CARD

MARINER DEPLOYED...



...expanding to eight Satellite Processors at down-to-earth cost!

Make MICROMATION's MARINER your entry-level system. System expansion is easy and inexpensive; plug in another Satellite processor card, connect a terminal, and you have multiprocessor, multitasking lift-off!



Each user has his own processor and 64K bytes of dynamic RAM, keeping MARINER performance up under loads that make single-processor systems sag. A separate 4-MHz Master processor and memory hold costs down by managing the sharing of MARINER's built-in 22M-byte Winchester disk drive, 8-inch floppy disk and 1/4-inch streaming tape drive.

There's nothing nebulous about MARINER's flexibility. Operate with CP/M, MP/M, or the new, high-speed DBOS (CP/M compatible) and you'll have a galaxy of software available for applications.

Program satellites with BASIC, COBOL, or FORTRAN, use them for word processing, general accounting, any of a multitude of tasks, each with complete independence. And MARINER's M/LINK modem communicates at 2400 baud on standard voice-grade phone lines, using SDLC, BI-SYNC, or X.25. Sounds universal? MARINER is.

MARINER's attractive, freestanding cabinet houses the Master and up to eight Satellite processors. And it's only 14″ x 20″ x 29″ in size, so it fits in beautifully, quietly, anywhere!

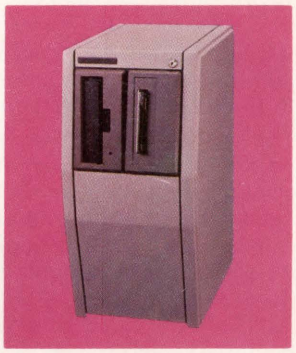
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The background to the MARINER system on the facing page is a photograph of the Lagoon Nebula, which can be seen with the aid of binoculars in the constellation Sagittarius.

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MICROMATION

CIRCLE 19 ON INQUIRY CARD

MICROPROCESSORS/ MICROCOMPUTERS

A step toward the ultimate personal computer

Suppose a designer could assemble any practical hardware and software configuration into the ultimate personal computer. What would it look like? Your ultimate personal machine would need to be compact, of course, so one multi-platter hard disc should suffice for bulk storage. Its terminal might team a high resolution color graphics display with an extended keyboard, rich in special function keys, and a "mouse" for positioning the display cursor. A dedicated mainframe would make a good processor if it were nicely packaged and frugal of power. But what about software?

Although a variety of dialects is desirable or even mandatory in a time-sharing environment, it makes no sense to cram every available programming language onto a personal computer. Even a limited subset or representative cross section of languages will result in compatibility problems, a clutter of documentation, and increased overhead to handle many sets of development tools. Instead, the processor architecture should support one ultimate high level language that is used exclusively throughout the system.

If pressed to choose only one language, many programmers would select a candidate that they have heard much about, yet perhaps never used. It has been described as *the* language of artificial intelligence, a high level machine language, a meta-language. Called LISP, it runs on only a handful of computers, but implements some of the most significant algorithms devised during the past two decades.

Several arguments favor LISP as the language of choice for a unilingual system. Perhaps the most compelling is that LISP was adopted and refined by researchers at eminent artificial intelligence centers: people who demanded and got the very best program development tools, and then proceeded to improve them. Encased within its sophisticated computing environment, which literally extends the language and continues to evolve, LISP is today ideal for large and intelligent programs that solve significant, generally open problems.

Since the mid-1970s, a wirewrap prototype called "the LISP machine" has been operating in a laboratory at MIT. Although its instruction set resembles its namesake language, the LISP machine has a general purpose architecture optimized for high performance programming in any symbolic language. It runs LISP programs several times faster than a small mainframe would, and in roughly half as much memory.

A commercial version of the LISP machine, manufactured by Symbolics, Inc, 21150 Califa St, Woodland Hills, CA 91367, has many characteristics of the ultimate personal computer. Costing less than $100,000, the Symbolics LM-2 includes an 80M-byte disc, an 800- by 900-pixel CRT display, an extended keyboard with mouse, and a 4M-bit/s local network interface. The heart of each single-user LM-2 is its customized 32-bit processor, which resembles the KD-10 CPU of a PDP-10 and has 1M bytes of main memory (expandable to 16M bytes), a 64k-byte virtual memory space, and 237 specialized microinstruc-

(continued on page 40)



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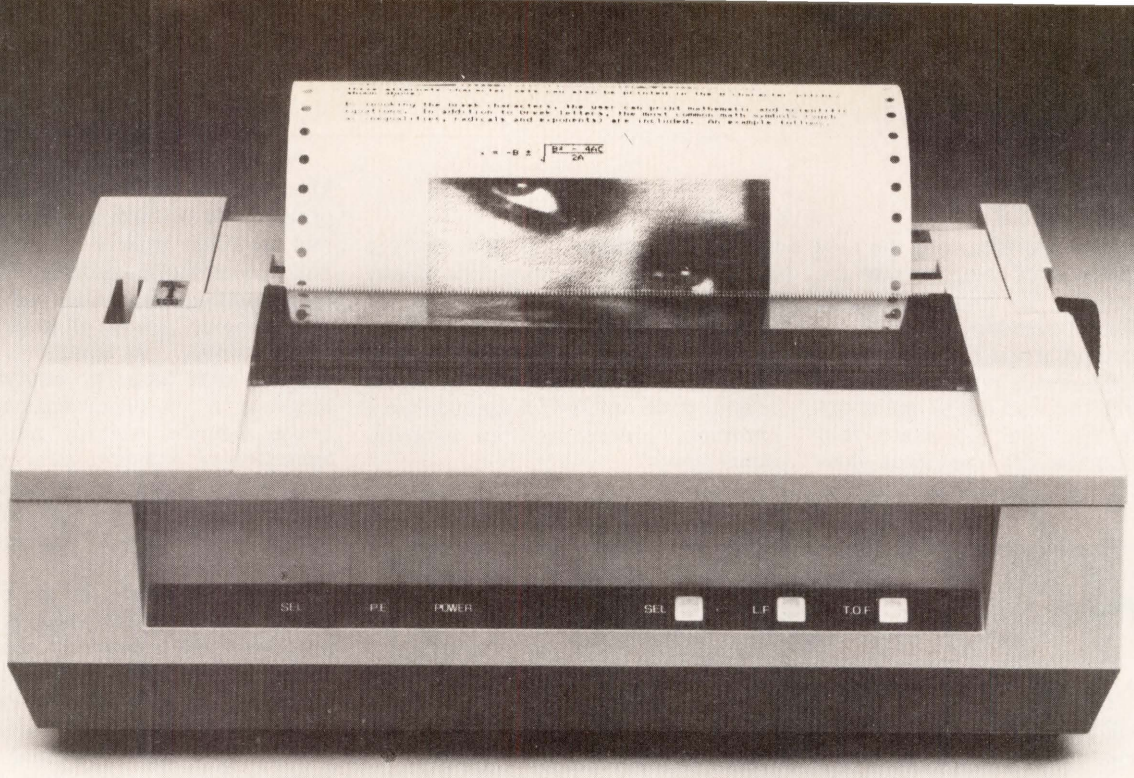
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13. 1.3K-byte buffer is standard for high-speed data transfers and more efficient utilization of computer time.
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FEATURE SHOCK

CIRCLE 21 ON INQUIRY CARD

tions. Software provided with the LM-2 includes 1M bytes of compiled LISP and 5M bytes of data that implement nearly 10,000 different functions.

The LM-2 is not a personal computer in the sense of hobbyist systems. Intended as a research tool and design aid, it embodies the "personal processor" concept that was first proposed as an alternative to timesharing, long before distributed processing came into vogue. Nevertheless, it is interesting to compare the cost and performance of an LM-2 and a basic hobbyist computer. For about 20 times the investment, LM-2 offers roughly three orders of magnitude more hardware, software, and raw computational power.

Few LM-2 owners will program in LISP. Most will run existing LISP application programs to perform specific functions that are often available only in a symbolic computing environment. For example, an LSI design system embedded in LISP combines a host of tools that interact through a common, object-oriented data base. In nearly natural language, it lets digital engineers construct, simulate, evaluate, and refine a large design in the most economical and reliable way. Associated tools include a PLA generator, node extractor, and router, all of which contributed to designing the LM-2.

A symbolic math package performs algebra and elementary calculus without introducing the truncation and roundoff errors usually associated with digital arithmetic. It can solve problems in dynamics, relativity, and physics; compute iterative expressions such as high order derivatives that are tedious to solve by hand; and extract integrals, polynomial divisors, or solutions to linear systems of equations. Developed at Project MAC in the MACLISP dialect, this program previously ran only under the Incompatible Timesharing System, whose name is both a caveat and a challenge.

By avoiding numerical calculations wherever possible, symbolic programs like the math package often arrive at exact solutions without loss of precision. Unlike conventional routines, symbolic programs can process an assignment statement such as $Y = mX + b$ even when X is undefined. Asked to compute 50!, the LM-2 pauses for barely a second before filling its screen with hundreds of digits that form the exact answer. It can as easily compute π to a comparable degree of precision.

Symbolic computation has the flexibility to handle real world objects and the versatility to connect these objects in arbitrary relationships. It also demands an efficient, highly specialized hardware environment optimized to store and manipulate symbols, their properties, and the relationships among them. LM-2, a complete symbolic computing environment, fills these needs with a LISP based, single user workstation, that gives designers and researchers most characteristics of the ultimate personal computer.

For more information

Byte, vol 4, no 8, Aug 1979 (LISP special issue)

S. R. Schoichet, "The LISP Machine," *Mini-Micro Systems, June 1978*

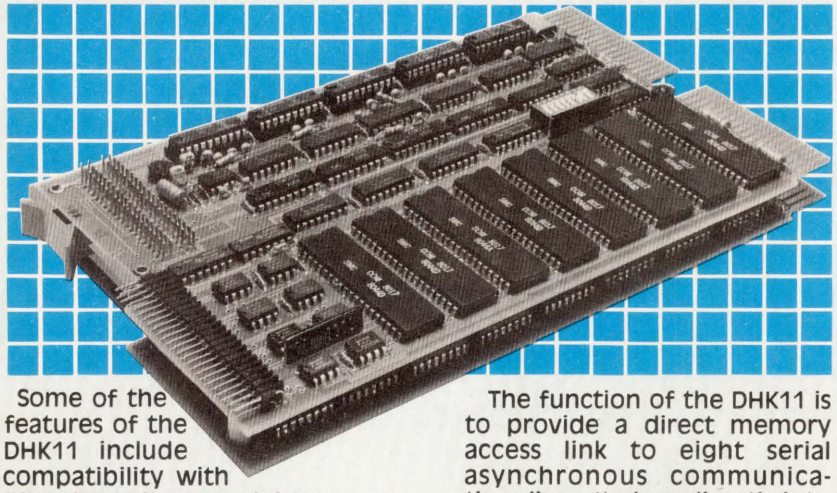
H. P. Winston and B. K. P. Horn, LISP, Addison-Wesley, Reading, Mass, 1981 (note the historical bibliography on pp 11-12)

—Shawn Spilman, Technical Editor

Circle 242 on Inquiry Card

DH-11 for LSI-11

DHK11 — the asynchronous multiplexer. It connects the LSI-11 with eight serial communications lines operating with individually programmable parameters. The excellent price/performance ratio of the DHK11 in conjunction with the LSI-11 make it an excellent choice for communication applications such as remote concentrators, front-end processors and forward message switches, especially now that the LSI-11/23 processor with RSX-11M multiuser software is available.



Some of the features of the DHK11 include compatibility with RSX11/M software; eight separate DMA output channels; and a 64-character input buffer. The construction of the DHK11 is modular, in groups of eight lines per set of two dual boards, requiring a minimum of backplane space. Optional modem control can be provided through the use of the DMK-11.

The function of the DHK11 is to provide a direct memory access link to eight serial asynchronous communications lines. It plugs directly into an LSI-11, LSI-11/2 or LSI-11/23 backplane or system. It consists of two dual size cards: 8¾" x 5¼". The cost? Talk to us . . . we are . . .

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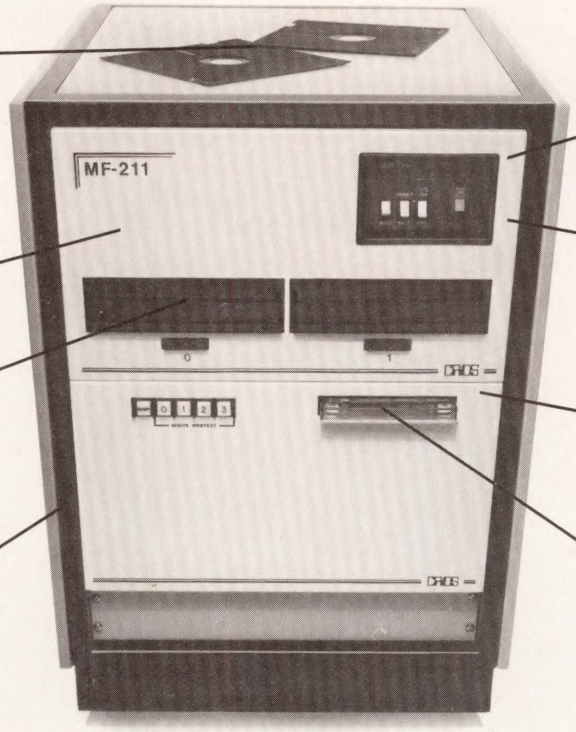
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CIRCLE 22 ON INQUIRY CARD

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See Us At COMDEX'81



UNIX-compatible Idris operating system, or DEC-licensed RT11V4

LSI-11/23 central processor with 128 kbytes of memory

Chassis with eight-quad-slot backplane and power supply

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Guess Again.

The price tag on this remarkably potent LSI-11/23-based system is just $16,000. That's well below the combined list price of its components and probably a lot less than you'd expect to pay. And this is only one of a whole series of 11/23 and 11/2 configurations we're offering right now at special complete-system prices.

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CIRCLE 23 ON INQUIRY CARD



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Back in 1969, when we introduced the world's first integrated 64-bit RAM, we literally started the whole revolution in memory design.

And we've stayed way out in front ever since. Because of all the companies in this business, we're the only one with the common sense to drive the design process in a full circle. From memory systems to microprocessors right on up to the next generation of memories, we just keep raising the level of technology higher and higher every step of the way.

It's that simple. Because we're the only company in the entire VLSI industry that designs a complete, state-of-the-art line of both memories *and* microprocessors.

What it amounts to is a definite feedback loop between our memory and microprocessor divisions. And you get all the benefits from it. Like easy upgrades. And faster design cycles.

You know the way it works: we introduce a new memory, and it drives the technology forward. Our microprocessor people take advantage of this new technology. And use it to design new architecture. Which comes full cycle and drives our memory design group, who take the technology even farther forward.

Of course, it really amounts to momentum. And nobody else in the entire industry has the momentum we do.

Or the track record. We brought you the first MOS static RAM. The first integrated dynamic RAM. The first EPROM. The first 16K E²PROM. The first 1 megabit bubble. In fact, of the 31 breakthroughs in VLSI over the last decade, we delivered 24 of them first.

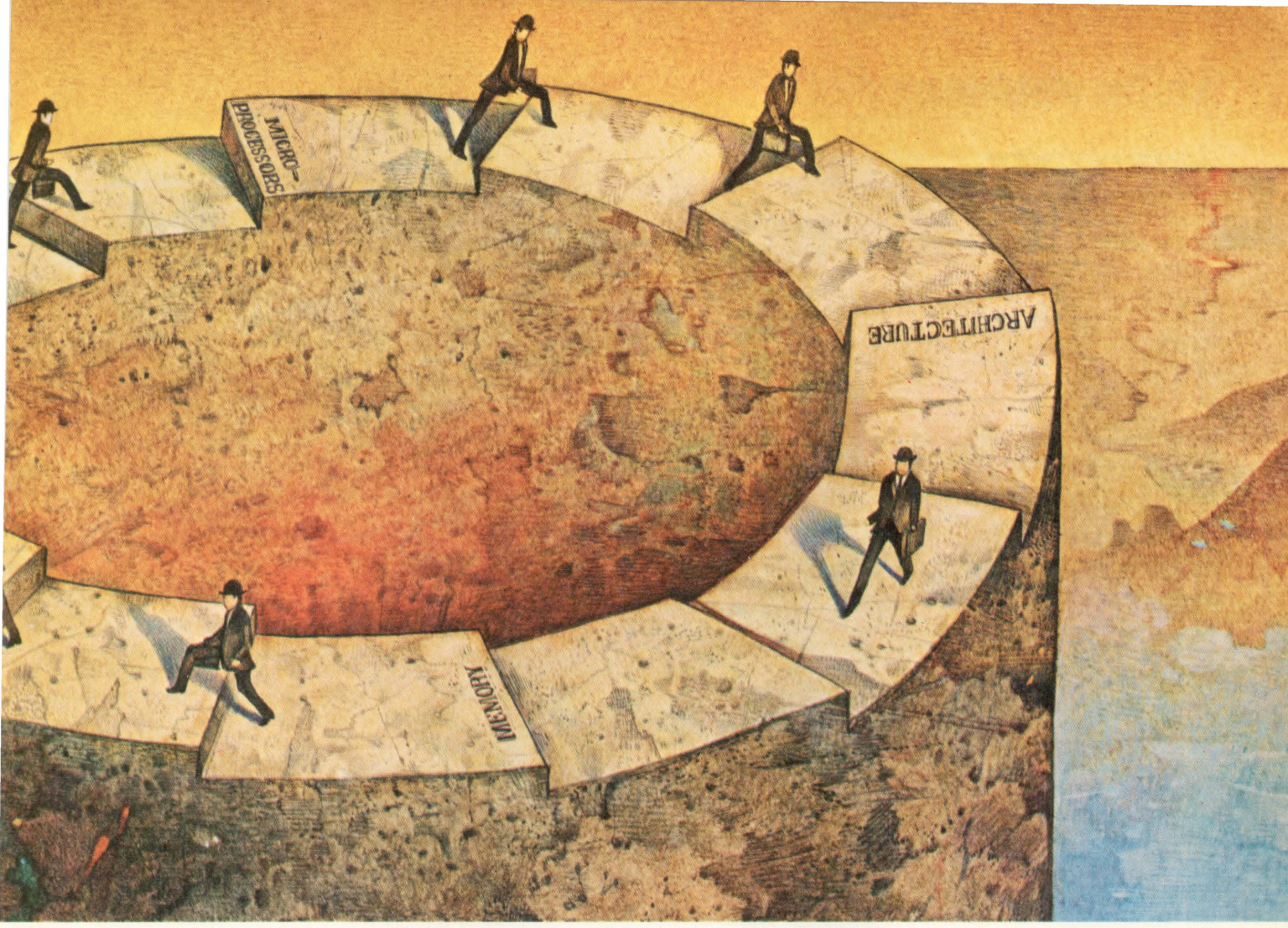
When you get right down to it, nobody else has the breadth we do, either. Our competitors might make memories for a few applications, but only Intel covers the entire scope of microprocessor-based products and gives you memories for every important system application. Commercial and military. Complete with development tools and applications support.

And since we plan to keep coming around full circle this way for years, we've invested an enormous percentage of our profits right back into our design and production capability. So we can deliver all the memory product you need. Right when you need it.

That's the broad picture. Now we'd like to show you product by product, how we're right on the leading edge of memory development.

RAMs

Ever since we introduced the first static and dynamic RAMs, we've gone on to develop just about every major breakthrough in this area to date. We're leading the way with redundancy techniques for high density 16K static and 64K dynamic RAMs. And with our new Series 800 family of RAMs, which we've designed to maximize effectiveness in specific microprocessor applications.



for a real breakthrough only one sensible way to go.

PROMs
Because of our process technology, we've always led the way in faster, denser PROMs, in MOS and bipolar.

In bipolar, we've developed a new process that gives our 16K PROM a 35ns access time. For its density, it's the fastest PROM available today. And with our new 32K, we'll take speed and density even further.

We're way out front with EPROMs, too. Because we invented them in the first place. And we've been upgrading them ever since. By giving you the first 5V only device. By establishing a complete byte-wide family.

And with our 16K E²PROM, we were the first to bring you in-circuit byte-erasability. And open whole new areas of design flexibility for you.

BUBBLES
We were the first to recognize the need for a complete VLSI system approach to bubble storage memories, and made ourselves the key driving force behind their acceptance, by producing the support circuitry which makes the total bubble solution easy to implement.

We're already producing bubbles in volume, with the yields supporting the long-term price guarantees we announced in 1980.

We've also introduced the Plug-a-Bubble™ System, which makes reprogramming in the field as easy as changing a cassette. And the iSBC™ bubble board, which gives you up to 512K bytes of memory and a Multibus™ interface on a single card. Of course, our bubble products are following the price guarantees we set last year, too.

SYSTEMS
Our innovations show up just as often at the board level and system level. Where we're constantly improving the cost/performance per bit in add-in and add-on memory systems and off-the-shelf standard OEM memory systems.

Just as one example, our Series 90 standard memory system is now available with the iQX intelligent controller, which brings new levels of reliability and maintainability to memory systems.

MEMORY SOLUTIONS
We've put together a new 64-page booklet that covers all our memories. It's called Memory Solutions. And we'd like you to have a copy. So get in touch with your local distributor or Intel sales office. Or write Intel Corporation, 3065 Bowers Avenue, Santa Clara, CA 95051. Or call us at (408) 987-8080.

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CIRCLE 24 ON INQUIRY CARD

MICROPROCESSORS/ MICROCOMPUTERS

Desktop computer combines word processing with graphics functions

With an entry level price below $7500, the HP 125 combines personal computer, word processor, computer terminal, financial calculator, and graphics workstation into a desktop business computer. Hewlett-Packard Co, 1507 Page Mill Rd, Palo Alto, CA 94304, has aimed the machine at financial analysis, word processing, and management communications applications. In addition to performing local processing, the CP/M based machine can become a full-fledged remote terminal to a large mainframe computer through dual RS-232 data communications ports at speeds to 9600 baud.

The machine gains power from a pair of Z80A microprocessors. With 64k-byte memory, the system processor is dedicated to program execution while a separate terminal processor supplies terminal intelligence. This allows most functions to be performed using eight soft keys, with functions labeled on the screen. For inserting and deleting information, a full complement of editing keys produce a "what you see is what you get" image on the screen. Five full pages, each with 120 lines of displayed information, can be stored. Key controlled scrolling allows review of long reports or earlier work.

By using the industry standard CP/M operating system, the system assures users a wide range of applications packages. Users can buy solutions to various business problems in the form of field proven software for use in accounting, data management, medical billing, and investment analysis.

Among the software packages supplied by HP are VISICALC™/125, GRAPHICS/125, WORD/125, BASIC/125, and LINK/125. Through LINK, users can transfer files to and from an HP 3000 and execute IMAGE/3000 database management inquiry procedures, all by means of a pushbutton controlled dialog.

For software developers, programming tools are available for use with CP/M to create programs in BASIC, COBOL, FORTRAN, Pascal, PL/1, Assembler, and other languages. Software for CP/M compatible systems is transportable among machines from various manufacturers.

Two models of the system are available. Model 10 uses dual 5.25″ (13.34-cm) mini-discs with 500k bytes of mass storage; model 20, based on dual 8″ (20-cm) flexible discs, offers 2.4M bytes. Both can expand with additional disc drives. Each can also be used with integral thermal printer, letter quality printer, or 180-char/s serial dot matrix printer. Color graphics output is supplied through 1- or 8-pen plotters that attach to the system. Each model also includes dual data communications ports for connection to other systems or attachment to serial interface devices. Speeds to 9600 baud, and various protocols are available.

Prices start at $7460 for a system including processor, dual mini-disc drive, two RS-232 ports, and 80-char/s thermal printer. CP/M operating system is included.

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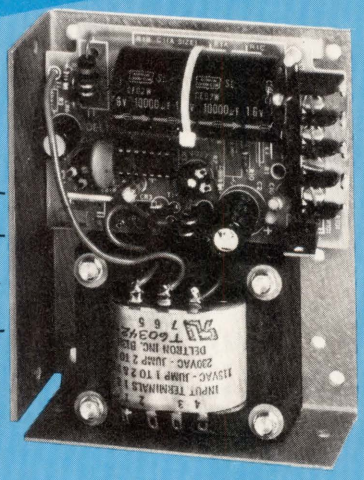
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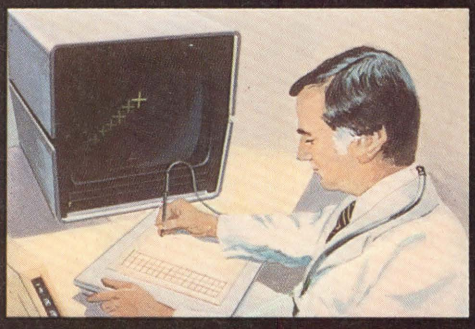
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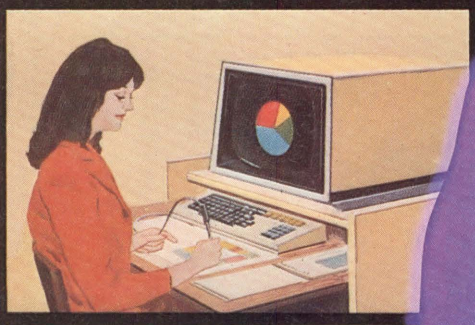
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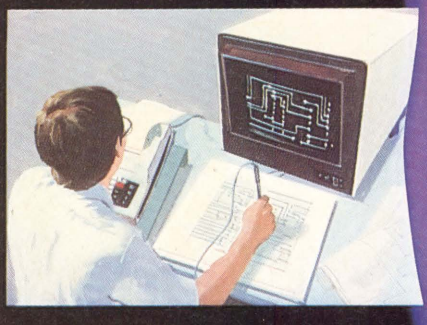


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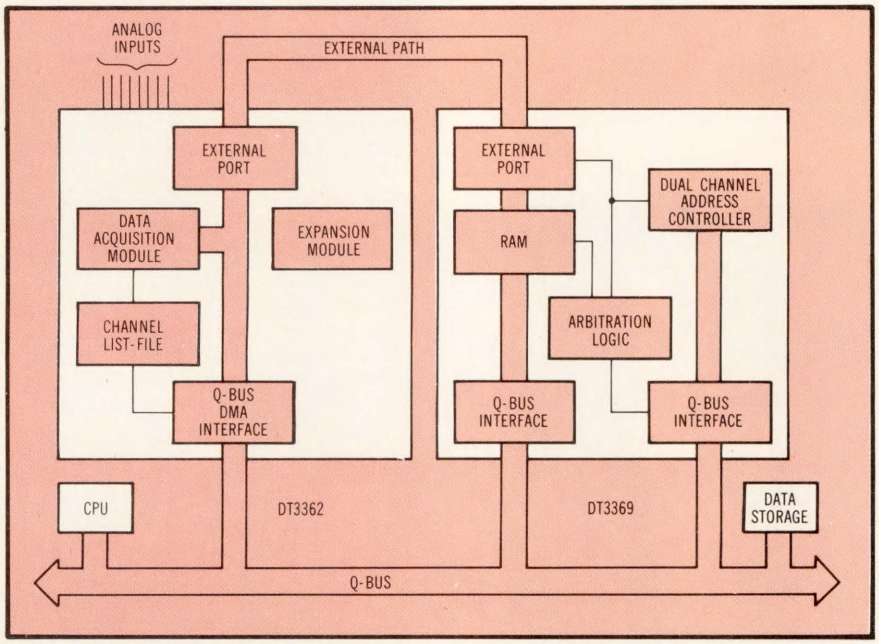
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CIRCLE 26 ON INQUIRY CARD

INTERFACE

Analog input card uses MUX channel file and dual-port RAM to double Q-bus bandwidth



With the dual-port architecture of the DT3362, the Q-Bus is needed only to move data from memory to disc. The external port on the memory card accepts data directly from the A-D system. Data can be loaded alternately into two separate buffers on the memory card; thus, while one unloaded to disc, the other can be filled via the external port.

Microcomputer interface cards featuring 12-bit data acquisition to memory throughput rates to 250 kHz via the LSI-11 Q-bus achieve performance with minimum Q-bus overhead. The DT3362 analog input card with high speed throughput option combines with DT3369 dual-port RAM card to come close to utilizing the full data transfer rate of the Q-bus. Characteristics of the cards, offered by Data Translation, Inc, 100 Locke Dr, Marlboro, MA 01752, meet the needs of array processors and other applications requiring multiple data conversion to memory transfers within short intervals of time.

The analog input card consists of a high speed, high level 12-bit, 16 single-ended or 8 differential channel data acquisition system (DAS) imbedded in an onboard Q-bus interface structure. An oncard 1024-byte RAM channel list file allows software selection of up to 64 channels. Software programmable logic performs I/O transactions in programmed, interrupt-driven, or direct memory access (DMA) modes while routing DMA transactions to either the Q-bus or its companion RAM and controller card.

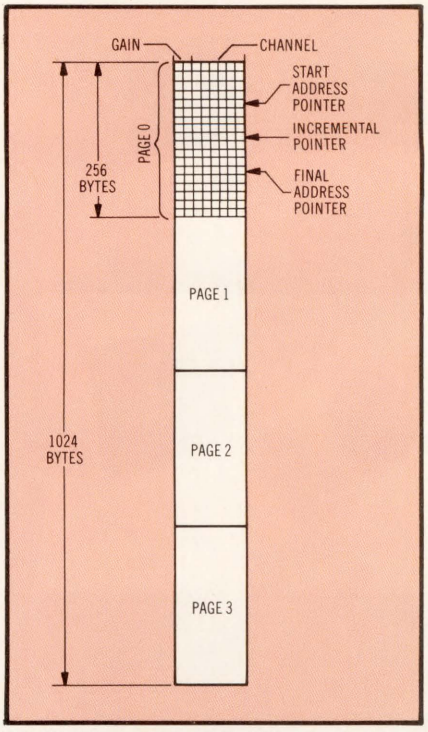
The standalone DT3362 with high speed optional data acquisition system can attain DMA acquisition to memory transfer rates to 250 kHz via Q-bus, provided other DMA activities and the processor are halted. The DAS/RAM card combination achieves the same 250-kHz transfer rate, while reducing Q-bus overhead for these transactions by a factor of two.

The DT3369 dual-port RAM and controller is a quad-height single-board memory system that is fully compatible with the LSI-11 Q-bus and DT3362 analog input system. Featuring two independent read/write ports—one interfacing with Q-bus, the other functioning as an external port that interfaces with the external port of the DT3362 via an independent external bus—the board supports high system throughput rates. With high speed performance options, the combination can sustain 250-kHz data rates, performing A-D to memory transfers via the external data bus and memory to external storage transfers via the Q-bus. Linking external ports of the two boards, the external bus bypasses the Q-bus, reducing Q-bus memory data transfer overhead.

The standard input card is supplied with 16 single-ended or 8 differential input channels; onboard 64 single-ended or 32 differential channels are options. The standard DT3369 board contains a 32k-byte block of dual-ported dynamic RAM complete with oncard refresh circuitry, jumper selectable location designators for Q-bus and port addressing, and a 2-channel DMA controller called the onboard address controller (OAC). The card can sustain both single- and dual-port operation to 0.25 MHz. It is also available with 128k bytes and without the OAC.

System performance derives from an architecture that transfers high speed DMA blocks of A-D to memory data directly from DT3362 external port to the compatible RAM card via external bus. Ensuring no loss of converter data due to faulty data bus scheduling, the external bus provides an independent committed data path that leaves the Q-bus free during the time normally required for A-D to memory transfers and associated arbitration latencies. Properly used, this bonus time can double the effective Q-bus bandwidth relative to conventional system architectures.

The DT3362 also contains a 1024-byte random access memory multiplexer channel file that is organized into four



Multiplexer channel list file on Data Translation's analog input card permits sampling sequences of up to 256 continuous scans to be programmed

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CIRCLE 27 ON INQUIRY CARD

INTERFACE

independent 256-byte pages. (See illustration.) Each byte in each page in the list can be programmed by the user with 2 bits for gain (1, 2, 4, or 8) and 6 bits for channel number. While a 2-bit page select code grants access to each page, software programmable 8-bit wide pointer logic determines the order in which selected channels become accessible to processor and conversion logic. This allows up to 64 different channel addresses to be stored in the file in any desired order, permitting users to perform sampling sequences consisting of up to 256 continuous scans.

The processor on the Q-bus has read/write access to the onboard RAM so that it can store (and read) channel numbers under software control. When the A-D conversion process is started, an incremental pointer in the A-D hardware starts at the programmed start pointer for the list and increments through the list to the final address pointer.

An example of the flexibility provided by the RAM channel multiplexing is its use to scan three channels. The A-D multiplexes three channels (eg, 0, 1, and 2) and then starts over. No time is lost scanning all 16 channels and no extra memory is required to hold values for absent channels. The three channels can be any three channels in any order. Final address and start address points can be loaded with the same value, causing the incremental pointer to stay at the same location in the list and causing one channel to be sampled by the A-D. In scanning different channels at different rates, the system multiplexes through the list from start to final address pointer. If the A-D is set to 200 kHz, channel 0 is scanned at 100,000 samples/s, but channels 1 through 5 are sampled at 20,000/s.

Seven software selectable conversion modes offer further versatility. Two non-DMA operational modes give a choice of program or external trigger initiation of single-step A-D conversions; two semiburst DMA modes—one program initiated, the other begun by an external signal—repeatedly perform A-D conversion and DMA transfer to memory on channels within one full scan of the multiplexer channel file until the number of conversions and transfers to memory equals that specified by the DMA word count register. Two burst-DMA modes perform, in one continuous burst, the conversions and transfers specified by the word count register. The final conversion triggering mode performs externally initiated A-D conversions and data transfers to memory using DMA logic and protocols. This software configurable mode enables each external trigger (or clock tick) to start conversion of each multiplexer channel as it appears in the channel list file, continuing until conversions and data transfers equal the number specified by the DMA word count register.

Price for DT3362 with 16 single-ended channels and throughput of 50 kHz is $2395. An H option to attain 250-kHz throughput adds $1100; the PGH option that supplies programmable gains of 1, 2, 4, and 8 adds another $175. The dual ported DT3369 RAM board with 32k bytes sells for $1675.

Circle 244 on Inquiry Card

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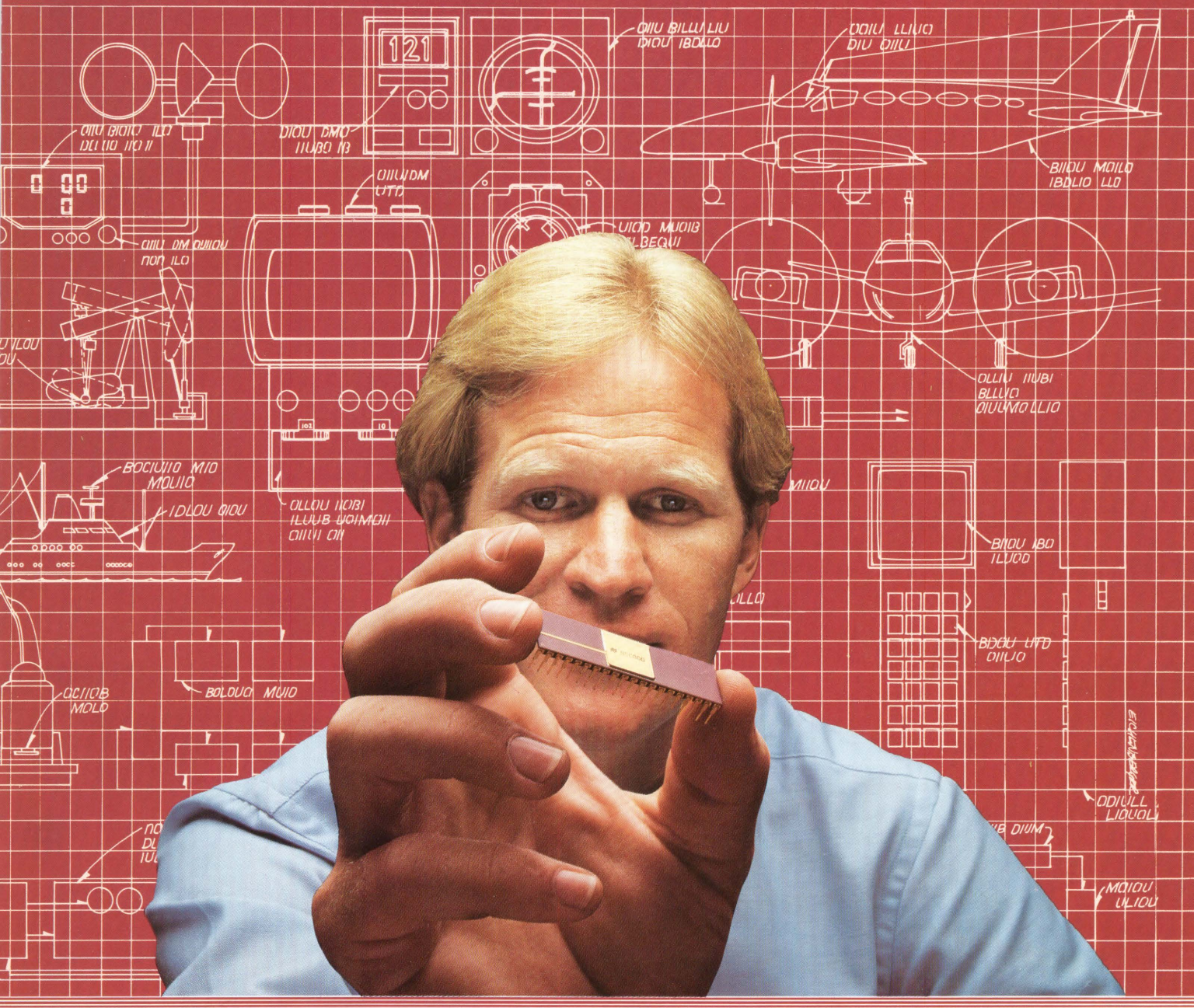
CIRCLE 28 ON INQUIRY CARD

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SPECIAL ISSUE

The new low power, high performance μP.

CMOS DESIGNS ARE NOW POSSIBLE WITHOUT SACRIFICING SPEED OR PERFORMANCE.



SPECIAL NSC800 ISSUE

The NSC800 brings low power plus high performance to μPs.

National's new P²CMOS™ μP combines the best of the Z80® and the 8085.

The best features of two popular NMOS chips are now available in CMOS. But not just any CMOS. National's high density P²CMOS yields a low power microprocessor family that matches NMOS speeds.

The NSC800 offers the multiplexed address and data bus of the 8085 and the sophisticated register and instruction set of the Z80. By taking advantage of a multiplexed address and data bus, we were able to free up extra pins and put more functions on the CPU, such as five interrupt levels, clock generation, bus control, and a unique power-save feature.

The NSC800 CPU uses the powerful 158 instructions, 10 addressing modes, and 22 registers of the Z80. Fully Z80 software compatible, the NSC800 also executes 8080 and 8085 code (with the exception of the RIM/SIM). Yet the NSC800 dissipates only 50mW operating at 5V at a 2.5MHz clock speed.

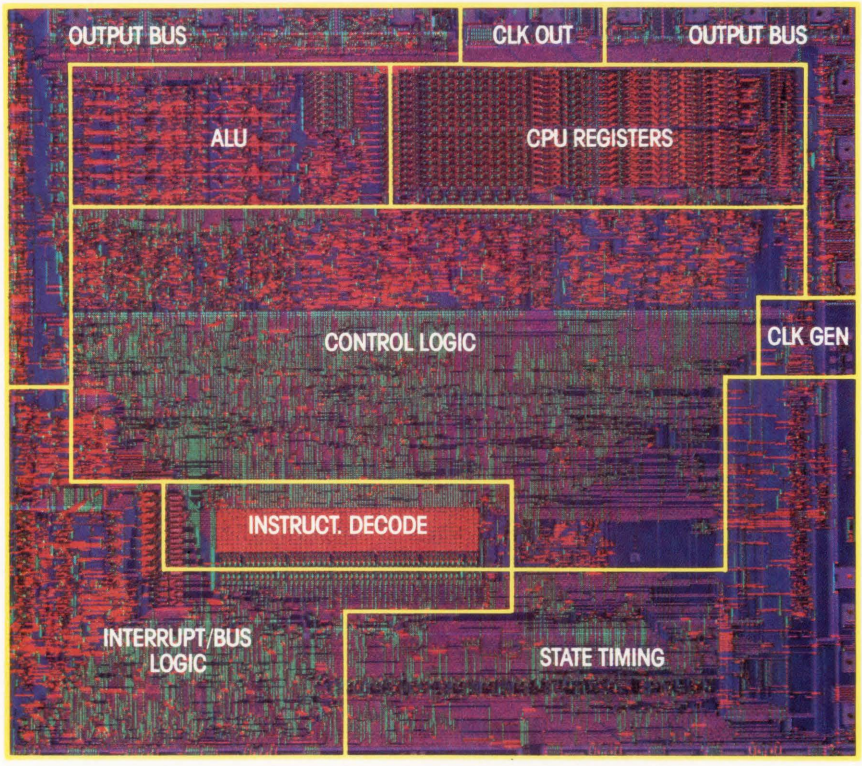
The other family members are the NSC810 RAM-I/O-Timer and the NSC830 ROM-I/O. Featuring two programmable 16-bit timers and 22 I/O lines, the NSC810 also provides 128 bytes of RAM.

The NSC830 provides 2K bytes of ROM plus 20 additional I/O lines. For extra design flexibility, all 42 I/O lines of the NSC810 and NSC830 may be independently defined as inputs or outputs.

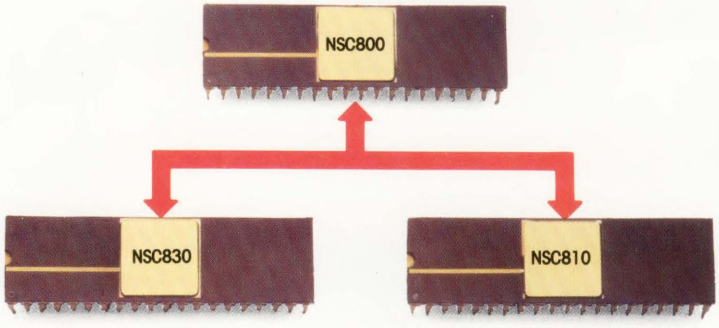
Additional P²CMOS support. A new line of logic circuits is also available. This family has the low power appetite of CMOS, while approaching LS speeds. The MM74PC04 hex inverter, for example, dissipates only 75μW, but boasts a propagation delay of just 12ns.

If memory expansion beyond the 810 and 830 is required, National has you covered there, too. The NMC6514 RAM family and the new NMC27C16 and latched NMC6716 EPROMs match the NSC800's speed and low power.

P²CMOS makes it possible. The goal: keep the attraction of low power, but boost the speed and circuit complexity.



The powerful NSC800 dissipates only 50mW.



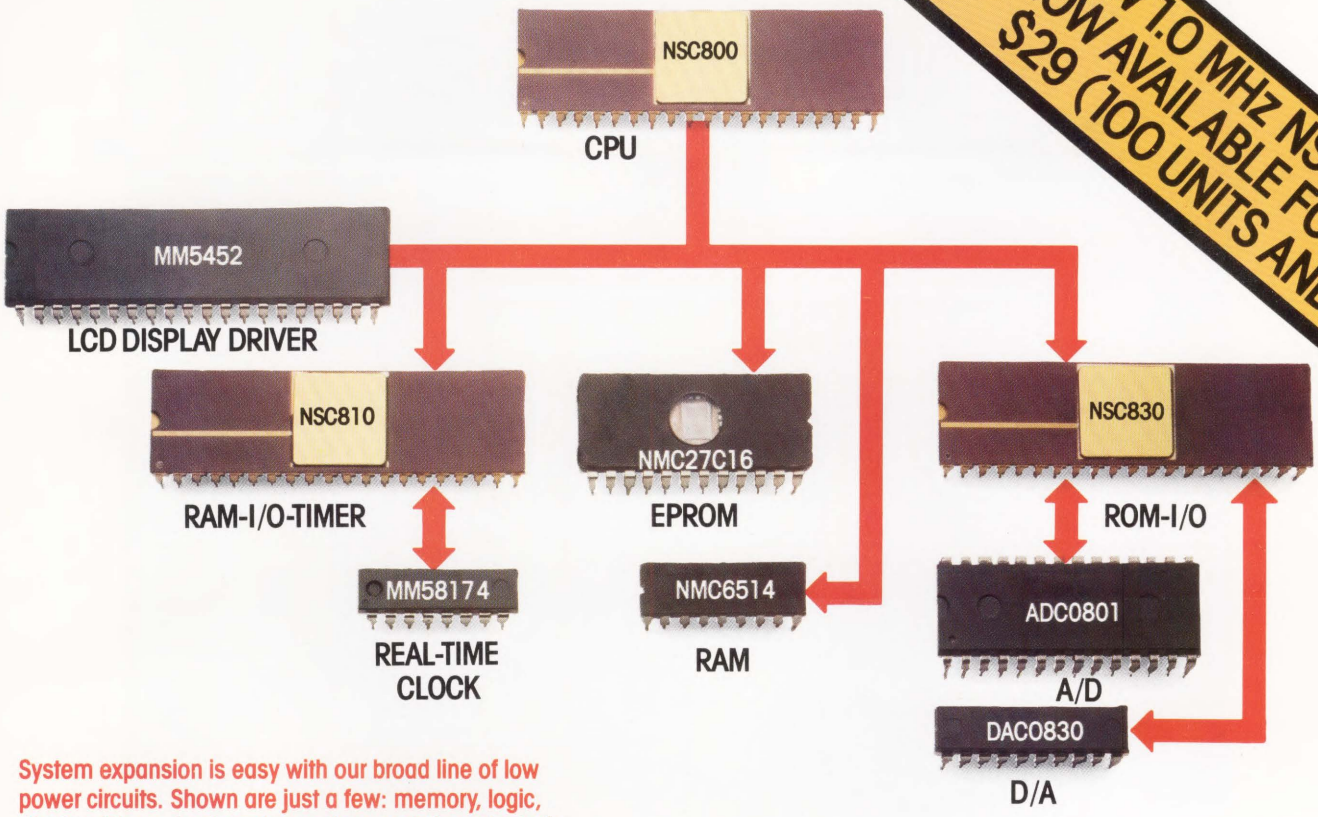
The heart of any system can be designed with just these three devices.

P²CMOS achieves this goal by using two layers of polysilicon in addition to the metal layer for interconnects. This silicon-gate, oxide isolated process yields decreased capacitance and increased circuit density. The final result—speed, a high degree of integration, and low power.

P²CMOS is an evolutionary extention of National's CMOS and XMOS™ processes. Products designed in P²CMOS are fabricated on a fully automated, high-volume production line.

Low power pays off. Now you can get the pay-off without sacrificing performance. For example, systems designed with low power circuits can be physically smaller. Power supplies, fans and cooling systems can be reduced or eliminated. PC boards can be designed for more dense configurations; and, if necessary, the whole system can be sealed for protection from harsh environments. And, of course,

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Built in Reliability. The lower the power dissipation, the higher the reliability. For example, consider the Θ_{JA} of the NSC800 in a ceramic package, which is approximately 40°C/watt. At 50mW power dissipation, the die temperature will only be 2°C above ambient. This allows the NSC800 to easily operate at 125°C. As an exercise left to the reader, calculate the corresponding die temperature of one of the mentioned NMOS devices.

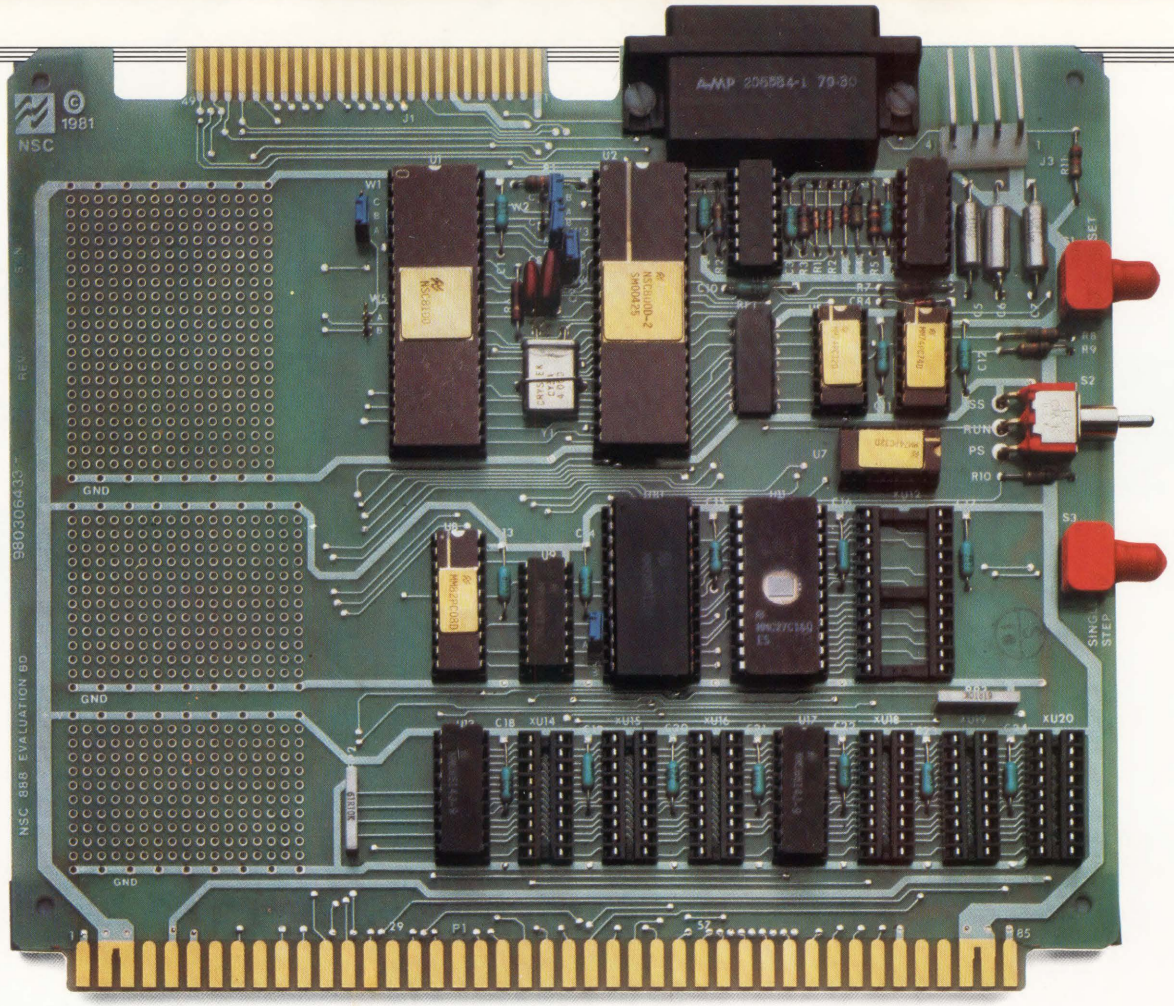
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INTERFACE
Data separator boards link discs and controllers

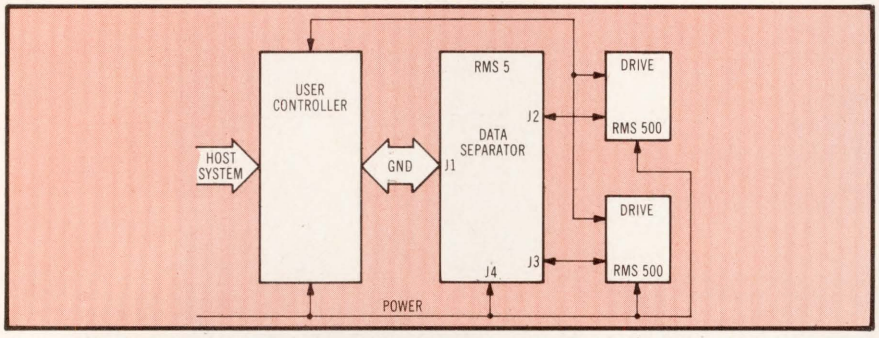


Fig 1 Typical 2-drive subsystem with data separator from Rotating Memory Systems. Disc drive control cables connect directly to host controller

Developed to ease the OEM integration of 5.25″ (13.34-cm) Winchester disc drives, Data Express™ data separators from Rotating Memory Systems, 1031A Duane Ave, Sunnyvale, CA 94086, are proprietary board level packages that provide data separation, write precompensation, and address mark generation/detection for the host system. Using a standard SA1000-type interface, the data separator is interfaced between the disc drive controller and one or two disc drives (RMS 500 series). A typical 2-drive system is shown in Fig 1.

Two models are available. Data Express/1 provides MFM (modified frequency modulation) data encoding and decoded information is provided by NRZ input and output.

All lines associated with the transfer of data and clock between the data separator and either the host controller or the disc drive(s) are differential in nature. A total of eight pairs of balanced lines are encountered on connector ports J1, J2 and J3. (See Fig 1.) The differential pair located on connector port J1 provides the data separator with data to be written on a selected drive in standard NRZ format. This signal is sampled on the leading edge of each Write Clock pulse also provided on this port from the host controller. Refer to Fig 2 for the timing relation between NRZ Write Data and Write Clock. The differential pair located on connector port J1 also provide a clock from the host controller to sample the incoming NRZ Write Data. The host system is required to toggle the NRZ Write Data lines at the falling edge of the Write Clock, since the data separator utilizes the rising edge to sample Write Data.

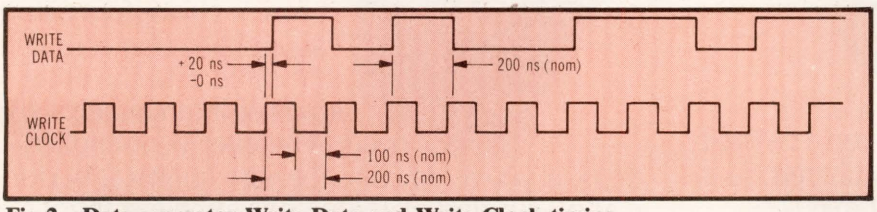


Fig 2 Data separator Write Data and Write Clock timing

5-MHz data rates for writing and reading. Data Express/2 uses an RMS "advanced code" that provides increased disc capacities of up to 50%. The advanced code is implemented by two custom VLSI encoder/decoder ICs. Data transfer rates are 7.5 MHz. Stable

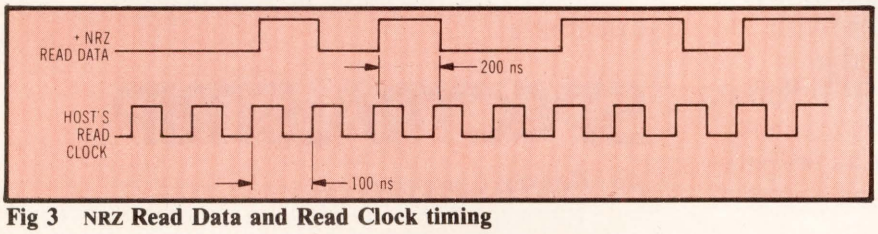


Fig 3 NRZ Read Data and Read Clock timing

The actual Read Data information appears on the pair located on connector port J1 16 μs after the activation of Read Gate, provided that Read Gate is enabled in a known field of all zeros or all ones. Refer to Fig 3 for the timing relation between NRZ Read Data and a typical sample/Read Clock.

The data separator is carried on a 7.7″ x 5.5″ (19.7- x 14-cm) printed circuit board that can be mounted within the drive or controller enclosure. It requires 5 ± 0.25 Vdc at 1.5 A maximum, 1.1 A typical, with 50 mV pk-pk maximum ripple.

—Douglas Eidsmore, Senior Editor

Circle 245 on Inquiry Card

Remote printer system saves line costs, eliminates host degradation

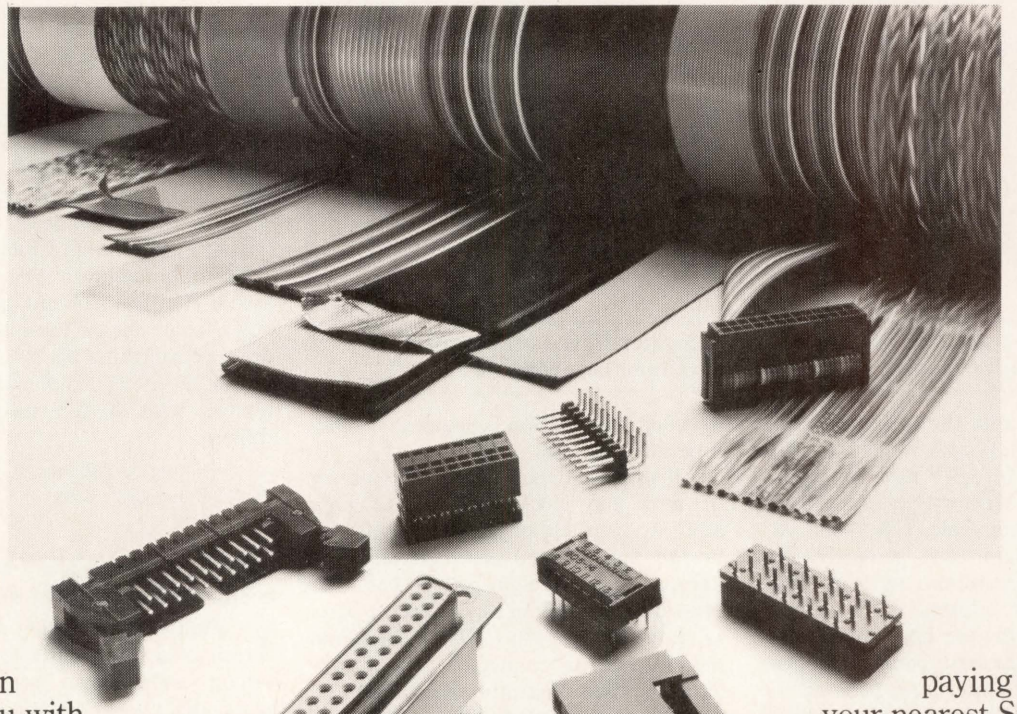
In addition to allowing remote operation of a line printer system, remote printer system also provides both a speed advantage over systems using normal communication protocols and automatic correction of transmission errors. Offered by Digital Associates Corp, 1039 E Main St, Stamford, CT 06902, the system is transparent to the host, requiring no modification of hardware or operating system software.

Operating from the printer port of the selected minicomputer and transparent to all communications protocols, the system permits high speed line printers to replace standard serial printers at remote sites. It compresses transmitted data to save on line costs and virtually eliminates the minicomputer degradation that typically occurs in data communication applications.

In addition to the controller/interface and printer that make up the standard printer system, the remote printer system (RPS) includes a transmitting unit; a pair of 2400-, 4800-, or 9600-baud modems located at the host and remote site, respectively; and a remote receiving unit. The transmitting unit interfaces directly with an existing controller interface. The local printer may be operated either through a second printer port (ie, as an independent second printer system) or, by external

(continued on page 55)

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CIRCLE 30 ON INQUIRY CARD

INTERFACE

switch selection, from the same controller/interface that drives the transmitting unit of the RPS. The system includes provision for data compression, by reducing the number of nonprintable characters (spaces) transmitted, and automatic error correction.

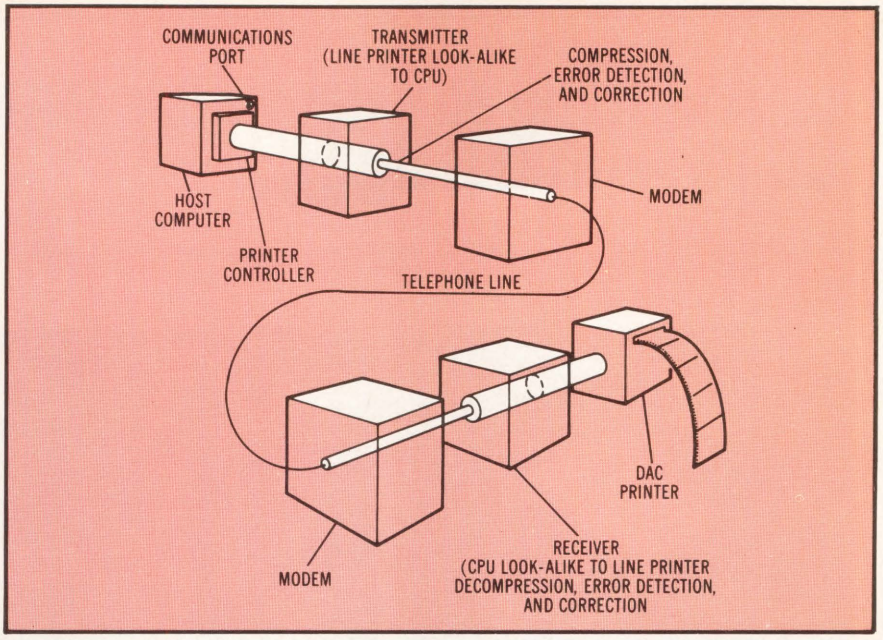
In operation, the system accepts a complete print line from the controller, and reduces the number of characters to be stored in the transmit buffer and subsequently transmitted. This reduction is accomplished by placing the print symbol immediately after the last printable character to suppress blanks at the end of the print line, and substituting a 2-character sequence of control character and space count for sequences of three spaces or more between printable characters within the print line.

The effect of this operation in terms of print lines transmitted is highly data dependent. The printer varies its effective speed according to the average line length actually presented over an extended period. For example, if a printer were operating at an average of 51 characters/line (maintaining a 300-line/min rate), it could normally receive 133-character lines for 24 consecutive lines before a slowdown occurred.

The system uses block mode error correction. Maximum block length is 512 characters; the average is somewhat less under the normal circumstance of less than 133 transmitted characters per line. Number of lines per block is a function of the average compressed line length.

In normal operation over the dialup network, a block of data with both character and block parity is transmitted to the remote site. Upon recognition of the end of the block, the respective modems are automatically turned around for transmission from the remote site to the host. Either acknowledgment or request for retransmission is transmitted together with current printer buffer and signal status information. Modems are again turned around, and either the next block is transmitted or the block in error is retransmitted. Expected average reductions from maximum 1-way transmission speeds are 3% for 2400-baud circuits, and 6% for 4800- and 9600-baud circuits under error-free conditions.

When an erroneous block is detected, characters in error are flagged and replaced by retransmission. This minimizes the need for multiple retransmissions of a single block under high error rate conditions. Degradation of system performance from that of an error free channel under relatively high error rates (10^{-5}) is approximately 3.5%. With error rates in the 10^{-6} range, the average character transmission rate is reduced less than 0.5% from the error free rate.



Digital Associate's remote printer system, consisting of transmitting unit, pair of modems, and remote receiving unit, permits remote operation of line printers with automatic correction of transmission errors

Systems are available for use with DEC PDP-11, -8, and VAX systems, Data General Eclipse and Nova, and for Prime computers. Price of the remote printer system without printer is $5000. In conjunction with a 600-line/min drum printer for a DEC system, the price is typically $15,950.

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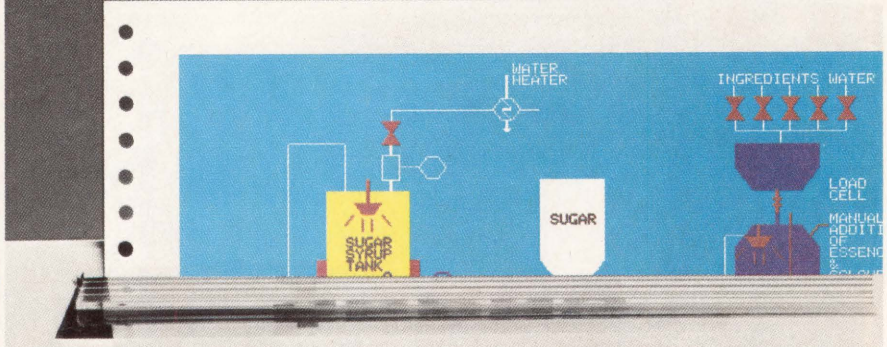
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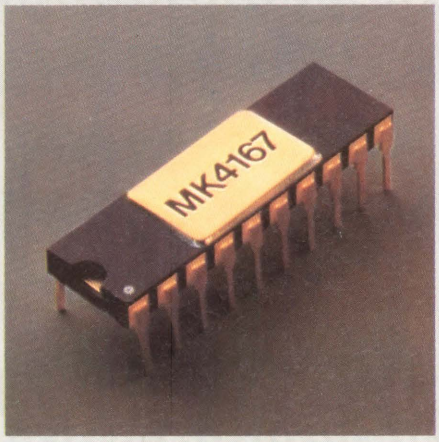
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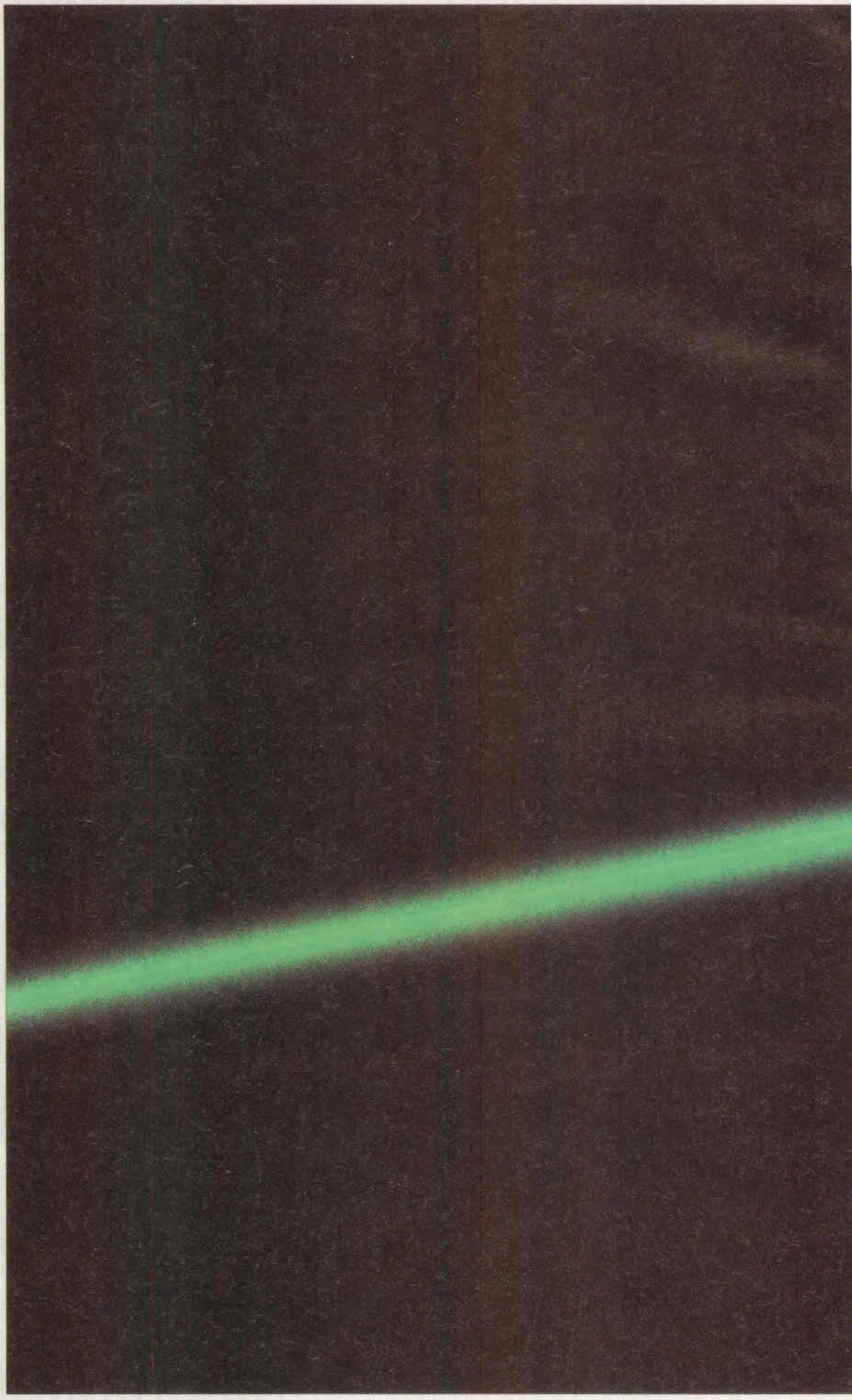
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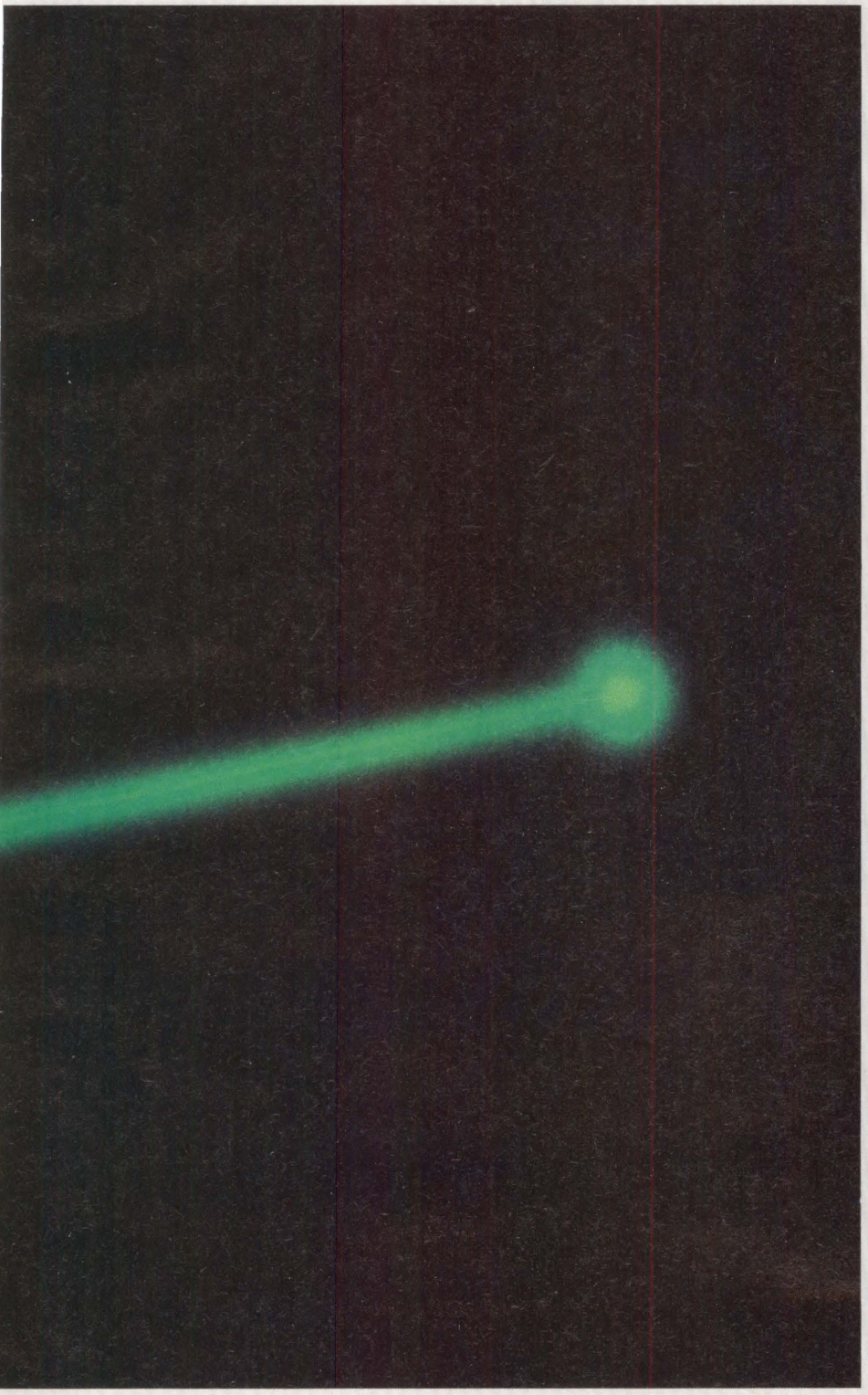
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On top of its other features, we designed the MK4167 to satisfy high volume demands. We enhanced manufacturability and lowered cost with smaller die size and redundancy. Redundant columns are used to replace non-functional bits, resulting in significantly higher yield per wafer.

LASER PULSES VAPORIZE LINKS

We use laser pulses to open polysilicon links and select redundant columns within the circuit. This technique completely isolates the non-functional bits. Mostek is one

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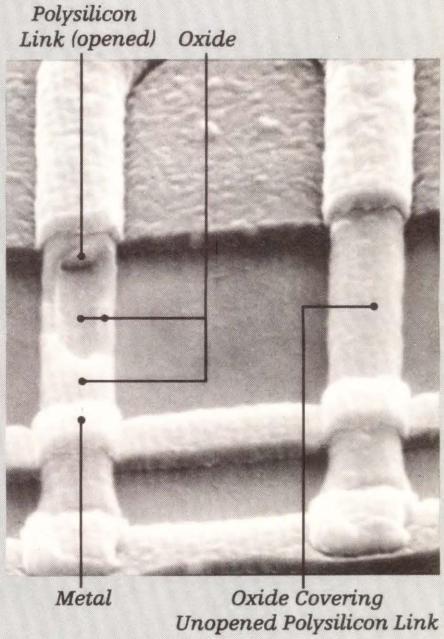


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Scanning Electron Micrograph of a polysilicon link which has been opened to select a redundant column. The link was vaporized by a precision laser pulse.

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CIRCLE 33 ON INQUIRY CARD

INTEGRATED CIRCUITS

N- and CMOS standard cells provide multiple interconnect methods and unrestricted die size

Standard cells are defined logic elements that can be connected by diffusion, metal, or polysilicon to form a digital LSI circuit. The technology is an alternative to gate arrays and conventional custom designs. With gate arrays, one or two metal layers are added to connect gates that are committed in silicon. Standard cells start without committed logic. Full custom chips, on the other hand, allow freedom in design but with penalties in cost, development time, and risk. American Microsystems Inc, 3800 Homestead Rd, Santa Clara, CA 95051, feels its standard cell system is a bridge between gate arrays and full custom chips. Standard cells are most cost effective for volumes of 10k to 100k circuits a year. Development times are typically 14 to 16 weeks.

Standard cells are available in both NMOS and CMOS. N-channel cells are smaller than the CMOS cells but are limited to 5-V operation. CMOS cells operate from 3 to 12 V and have lower operating current and near zero standby current. Cells are used as logic building blocks to design digital LSI circuits. The library contains 40 CMOS and NMOS cells including J-K and D flipflops; 2-, 3-, 4-, and 5-input NOR gates; 2-, 3-, and 4-input NAND gates; ripple counter bits; shift register bits; synchronous counter bits; inverters; clock drives; and latches. Intended primarily for digital applications, some analog cells such as voltage comparators are also being developed. The library of cells will be continuously expanded as new requirements arise.

Since cells have been previously designed, fully characterized, and tested, the time usually spent in circuit design is considerably shortened. Some circuit design effort is still required since the capacitance and resistance of interconnect lines must be checked to ensure that speed and power requirements are satisfied, but the major time saving in the standard cell system occurs in the area of layout. Cells are in a computer data base, and layout consists of arranging the cells in rows and then using metal and polysilicon interconnections between the cells. Working from a customer's logic diagram, the company uses a computer based interactive design system to layout the cell interconnect. Besides placing cells and interconnect, the interactive design system performs continuity checks, simulates signal delays, and creates a pattern generation tape.

A custom hand layout design will always result in a smaller die size than a circuit designed with cells. However, the company has minimized this penalty in a number of ways. For instance, basic N-channel gates have been designed in two different sizes, one for minimum power and size, the other for maximum speed. Also, inputs and outputs of the cells are available at both the top and bottom of the cells for maximum flexibility of interconnect. In addition, the cells can be "flipped" from left to right when this orientation results in shorter interconnect. Input and output devices also have two different layouts, depending on whether the die size is pad limited or open. For a large die, the input and output devices are short and wide. For a small die, the input and output devices are narrow and long. The long narrow I/O cells allow the maximum possible number of pinouts for a given die size.

—Douglas Eidsmore, Senior Editor

Circle 247 on Inquiry Card

TTL version macrocell development supported by regional design center

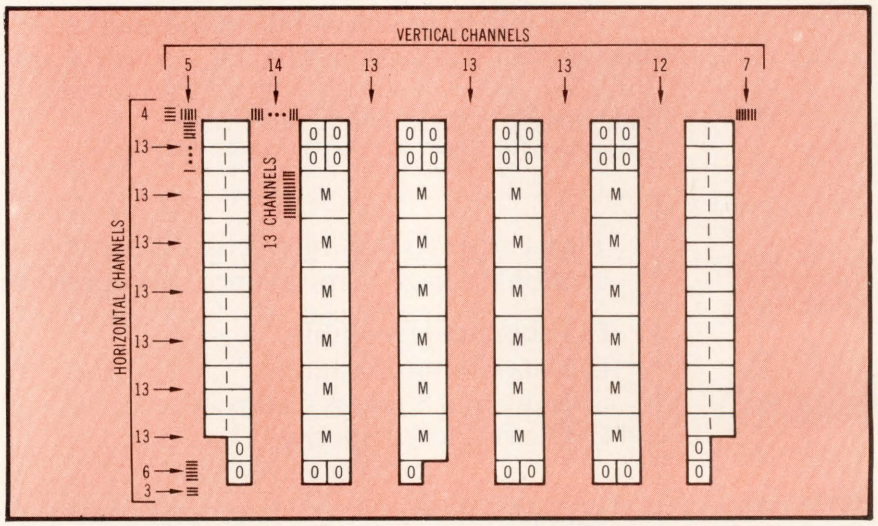


Fig 1 Motorola MCA500ALS Macrocell layout shows relative positions of macrocells within array. Horizontal and vertical routing channels connect macrocells. Each cell contains discrete logic. ECL major cells with ALS-TTL interface cells provide ECL series gated performance. Cell locations total 77: 24 major (M), 26 input (I), and 27 output (O)

Designed for the advanced low power Schottky (ALS) TTL market, the MCA500ALS Macrocell (gate) Array includes 24 major (M) cells, 26 input (I) cells, and 27 output (O) cells for a total of 77 cells. The arrangement of macrocells within the gate array is shown in Fig 1. Instead of using gates as the basic building blocks, macrocell arrays use cells of SSI/MSI logic (Fig 2). The cells and I/O pads are connected by user defined metal within horizontal and vertical routing channels. Each cell area contains a number of unconnected discrete transistors and resistors. Instructions for converting the discrete parts in each area into SSI/MSI circuits are contained in a computer-stored Macrocell library. To design a circuit, the designer selects functions from the library and specifies how they are to be connected. These instructions are entered into the company's CAD support system which does the placement and interconnect routing. Macrocells are manufactured by Motorola Semiconductor Products Inc, PO Box 20912, Phoenix, AZ 85036.

Only 24 of the 27 output drivers can be used because of output pin limitations. Each of the output macrocells has an optional TTL compatible 3-state control input. The three "extra" drivers can be used as 3-state control circuits to con-

(continued on page 62)

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CIRCLE 34 ON INQUIRY CARD

INTEGRATED CIRCUITS

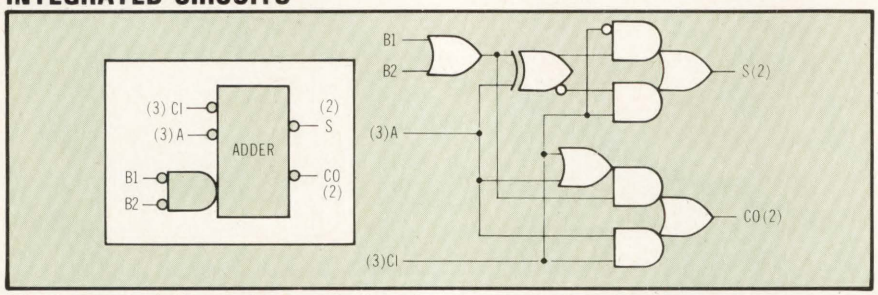


Fig 2 Typical Motorola macrocell with MSI complexity. Macrocell corresponds to full adder logic (right)

vert the standard output of internal major macrocells into 3-state control signals, thereby offering three 3-state output offerings.

If a major macrocell is used as a simple OR/NOR gate, propagation delay is typically 2.25 ns. Average delay through a more complex macrocell is 2.8 ns. Since macrocells average the equivalent of two gate levels, the effective major macrocell gate delay is 1.4 ns. It is difficult to specify a maximum gate count for the array without defining which macrocells are used. Dual adders result in the highest gate count of 533 equivalent gates. A more typical usage would be flipflop macrocells, which yield a 389 gate count.

Most of the MCA500ALS array power dissipation is due to TTL output drivers. ECL Macrocells, which do most of the logic, consume only a few hundred milliwatts. Power dissipation can be controlled by the number of outputs used and by selecting between 1- and 24-mA output drives.

The company has developed a CAD system to help the customer in developing a gate array. The customer determines the logic function to be performed by each macrocell array LSI circuit. The CAD system simplifies circuit design by simulating the design logic function, placing macrocells within the array, and automatically counting signals between the macrocells and the I/O package pins. The CAD system minimizes communications problems between the customer and the company's engineers.

To assist in Macrocell development, the company is establishing regional design centers at key locations throughout the country. These centers contain graphics equipment (Tektronix 4014 computer display terminal and 4662 or 4663 plotter) and a dedicated line to the company's Western area computer center. The first regional CAD center was recently established in San Jose, Calif.

Circle 248 on Inquiry Card

Hard array logic circuits are mask programmable PALs

Mask programmable versions of programmable array logic (PAL®) circuits have been developed for large volume flexible logic applications. Designated Hard Array Logic (HAL™) circuits, the devices are produced using standard low power Schottky technology and automated mask pattern generation. PALs are fuse-programmable. They can be used as prototypes for HALS. HAL circuits are available that correspond to each PAL family member. They can replace standard SSI/MSI components with a reduction in chip count and size. Both types of circuits have the equivalent of up to 200 gates and are implemented by programmable AND arrays driving fixed OR arrays.

To obtain HAL circuits, the user simulates a PAL using PALASM, an assembler program with simulator option provided by the manufacturer, Monolithic Memories, 1165 E Arques Ave, Sunnyvale, CA 94086. The user then supplies the design specification in one of three ways: through a computer-generated listing, a handwritten form included in the data sheet, or direct online transmission to the company's timesharing computer system.

After receiving the specification, the company performs design verification to ensure that the circuits perform the desired function. Comprehensive test vectors are also generated, allowing each node to be measured for stuck-high/stuck-low operation. The circuit is automatically routed at the same time that design verification is performed and test vectors are generated.

HAL circuits have worst case propagation delay times and maximum set-up times of 35 ns. The devices are available in commercial and military versions.

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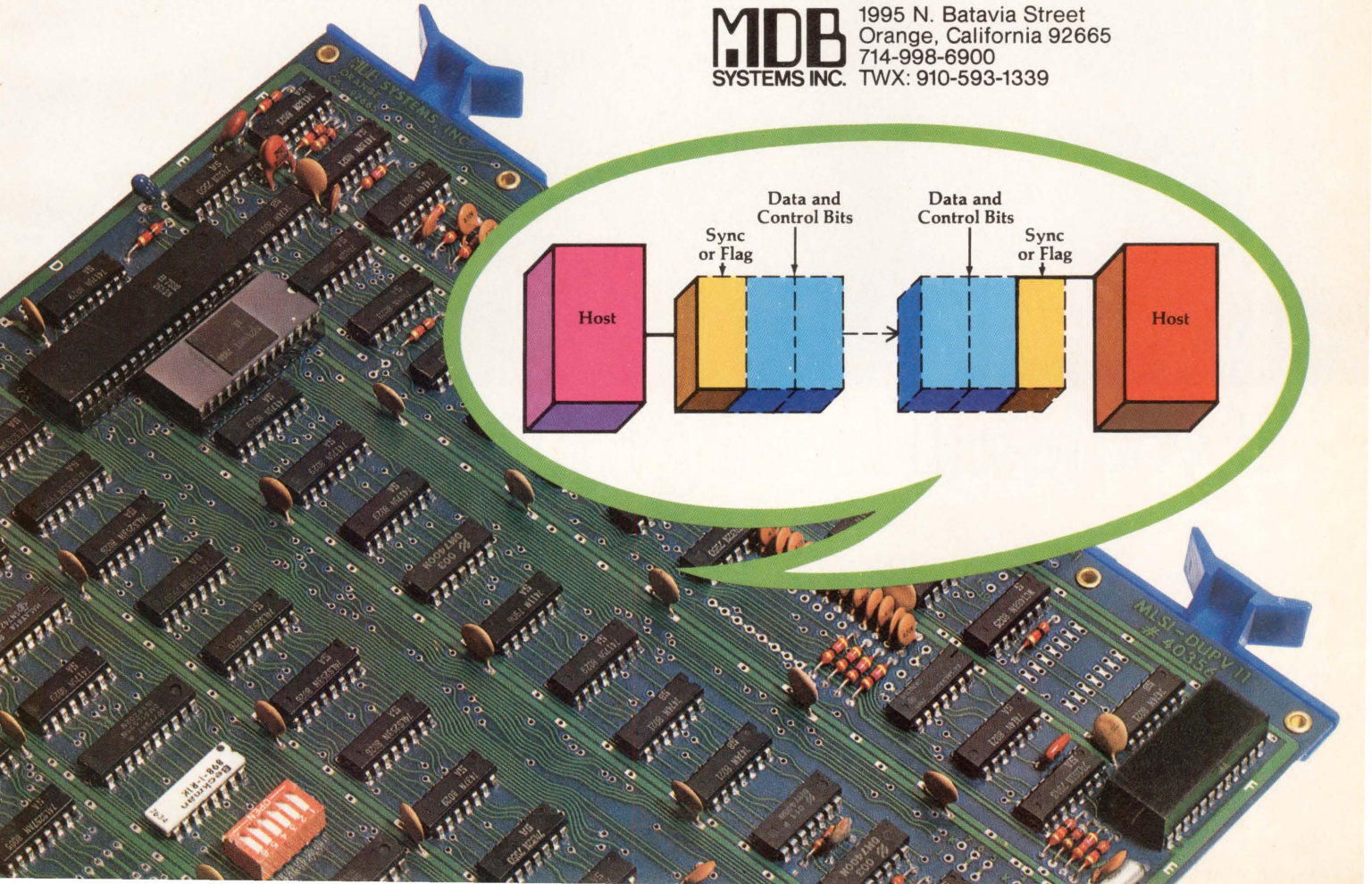
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Circle 35 for featured product data.
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CIRCLE 38 ON INQUIRY CARD

INTEGRATED CIRCUITS

Error correction chip increases system reliability by factor of 25

By detecting and correcting errors as data are read from RAM, the 8206 from Intel Corp, 2625 Walsh Ave, Santa Clara, CA 95051, can produce a 25 times increase in system reliability. Capable of handling 8- or 16-bit wide data, the chip is designed with flow-through architecture that uses separate 16-pin input and output data buses to overcome limitations of conventional error detection and correction units (EDCUs).

Requiring additional timing logic to control the EDCU bus, conventional systems must first latch input data, correct it, and then 3-state the bus before delivering corrected data. In contrast, dual buses allow read cycles with error correction to be performed without control signals or external logic. This is particularly useful in the design of systems implementing read-modify-write or byte-write cycles. In these cases, a transparent latch on the data in and check bit in pins replaces external hardware that may be needed for read-modify-write cycles.

A single 8206 can handle 8- and 16-bit wide data. Devices can be cascaded to handle up to 80-bit words. The chip uses a modified Hamming code to generate five check bits to detect and correct errors in 8-bit words, six check bits for 16-bit data, and eight check bits for an 80-bit word.

During write cycles check bits are generated for storage with the data in RAM. Then as data are read out, the chip generates new check bits, compares them with the originals, and flags the CPU on detection of an error. Functioning in series with memory data outputs, the chip can correct single-bit errors in 67 ns and can transmit a double- or multiple-bit error flag to the host processor in 52 ns.

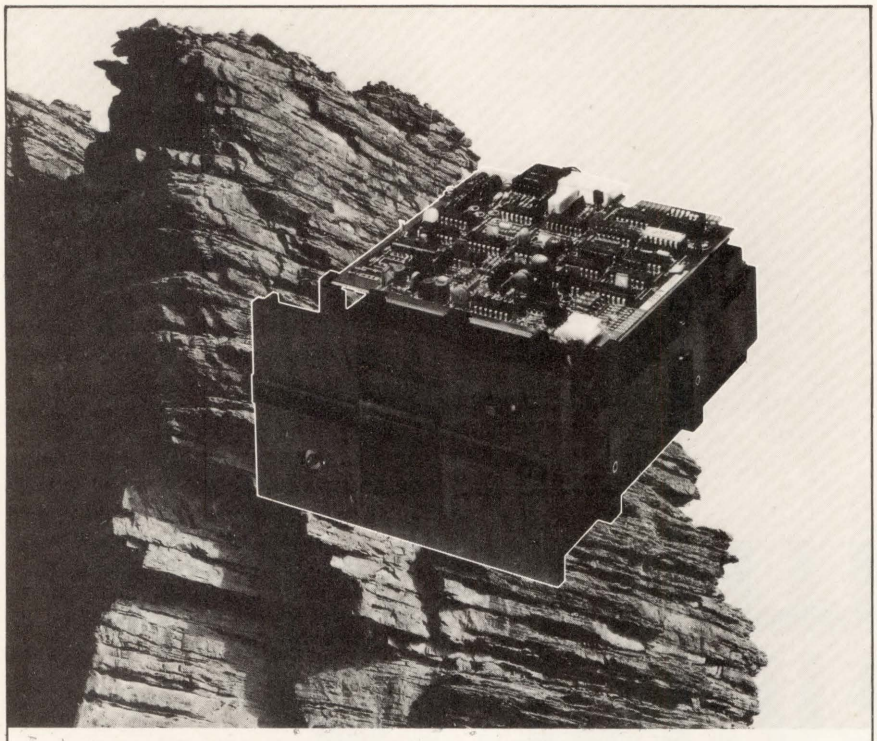
When the chip's error correction circuitry is turned off, data can flow through in 32 ns. When an error is detected, the chip sends a flag to the processor and the processor enables the correction circuitry using a single pin.

During read cycles, the chip's eight syndrome out pins identify the bit in error if an error has occurred. The syndrome can be latched for error logging, allowing a defective RAM to be replaced during regularly scheduled maintenance.

Packaging the die in a JEDEC type A 68-pin leadless chip carrier allowed the use of flow-through architecture with its separate input and output data buses. The carrier also permits extremely dense circuit board design and improves chip reliability by increasing heat transfer. HMOS (high performance metal oxide semiconductor) process technology reduces operating power consumption to approximately 1 W.

Because less random timing logic, and fewer gates and controls are needed to support the device, design is simplified. The device replaces 20 to 50 TTL circuits and requires one-sixth the power.

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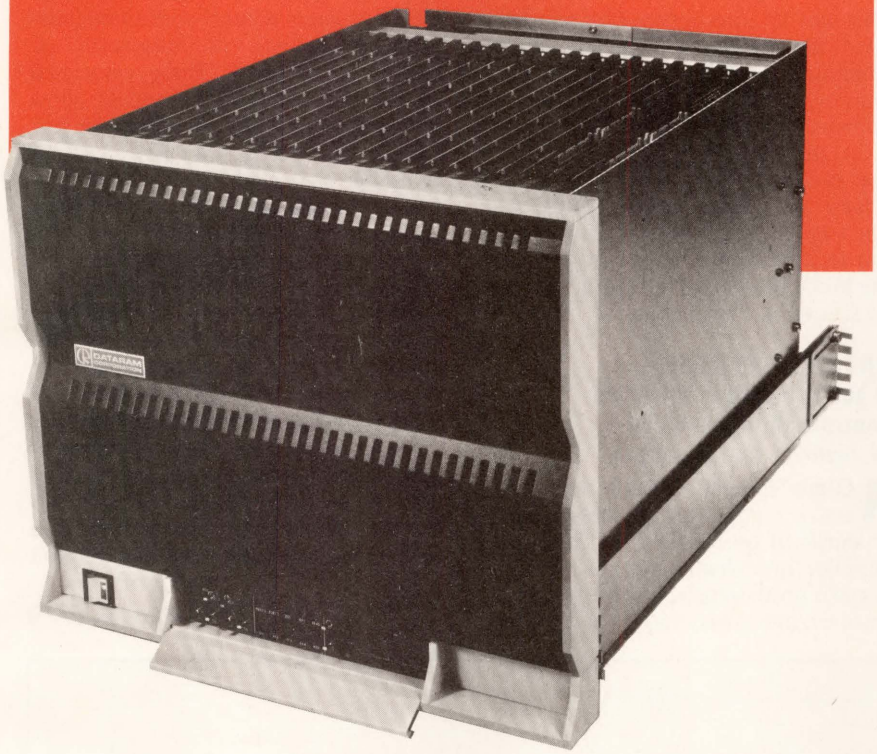
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CIRCLE 40 ON INQUIRY CARD

INTEGRATED CIRCUITS

RAM controller/drivers drive 4k through 256k dynamic memories

The DP8408 dynamic RAM controller/driver and the DP8409 multimode dynamic RAM controller/driver are capable of driving 4k, 16k, and 64k dynamic RAMs. From National Semiconductor Corp, 2900 Semiconductor Dr, Santa Clara, CA 95051, the 48-pin devices provide control and address signals for up to 88 devices (approximately 500-pF loads) with propagation delays of 20 ns. Automatic access modes eliminate the need for external delay circuitry and offer fast, closely matched control signal timing. DP8408 provides five modes of operation, including externally controlled refresh and access, all-RAS write (for initialization), plus fast and slow automatic access. These automatic access modes make dynamic memories appear static to the system designer. The device also has eight multiplexed address lines and an 8-bit refresh counter. System access may be controlled externally or onchip automatically.

Pin and function compatible with the DP8408 to facilitate future system upgrades, the DP8409 is expanded to eight modes of operation with nine multiplexed address outputs and control signals capable of driving 256k dynamic RAMs. In addition to the five DP8408 modes of operation, the DP8409 includes automatic refresh (hidden or forced), burst refresh, and all-RAS automatic write.

If a complex DP8409 application is designed such as one requiring auto access and refresh, burst refresh, and all banks auto write access, then more circuitry is required to select the mode. This may be accomplished by utilizing a PAL®. (See the Figure.) The PAL has two functions, one as an address comparator, so that when the desired port address occurs (programmed in the PAL), the comparator gates the data of the DP8409. Hence, the mode of the DP8409 can be changed as desired with one PAL chip merely by addressing the PAL location and then outputting data to the mode pins. All the auto modes may be selected in this manner.

DATA CONVERSION

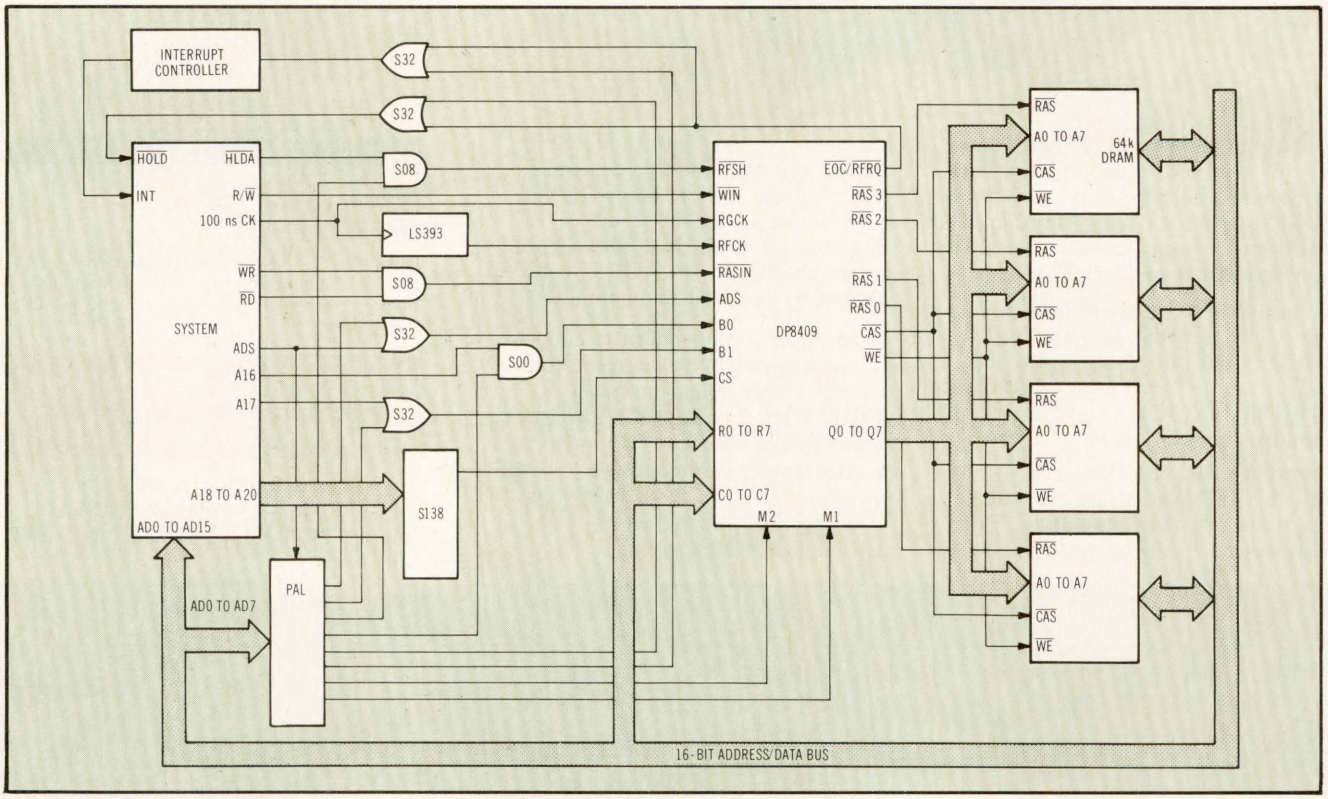
Q-bus compatible interface controls three channels of resolver conversion

A Q-bus compatible card that allows LSI-11 computers to obtain three channels of positional information and supplies three channels of analog output for axis positioning control, the DDC-5525 resolver/inductosyn interface serves as a subsystem for LSI-11 based numerical control systems. Applications for the device, developed by ILC Data Device Corp, 105 Wilbur Pl, Bohemia, NY 11716, include automatic control systems, automatic machining, and robotics.

Interfacing directly with the Q-bus, the board is addressed as four read cells and three write cells. It provides complete 3-channel control with three independent channels of inductosyn or resolver conversion. Three associated 12-bit D-A conversion channels allow servo motor control. The servo motor control portion of the card contains computer controllable gain for slew or fine speed control. The R-D converters can interface with resolvers and/or inductosyns as transducer inputs. Transducer excitation (10 kHz) is also provided.

Resolver to digital conversion provides a 12-bit value (4096 counts) equivalent to 0.088° (resolver) or 0.4883 μm (inductosyn). Accuracy is ±2 LSB. A 4-bit turns counter maintains number of full revolution or pitch transitions to provide absolute position. This is combined with the 12 bits of data from the R-D converter to obtain a 16-bit

(continued on page 75)



Complex system with National's DP8409 in auto mode with burst refresh capability. PAL is used as address comparator

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Software costs are low, too. CompuStar's disk operating system is the industry standard CP/M*. With an impressive array of application software already available and several communication packages offered, the CompuStar can tackle even your most difficult programming tasks.

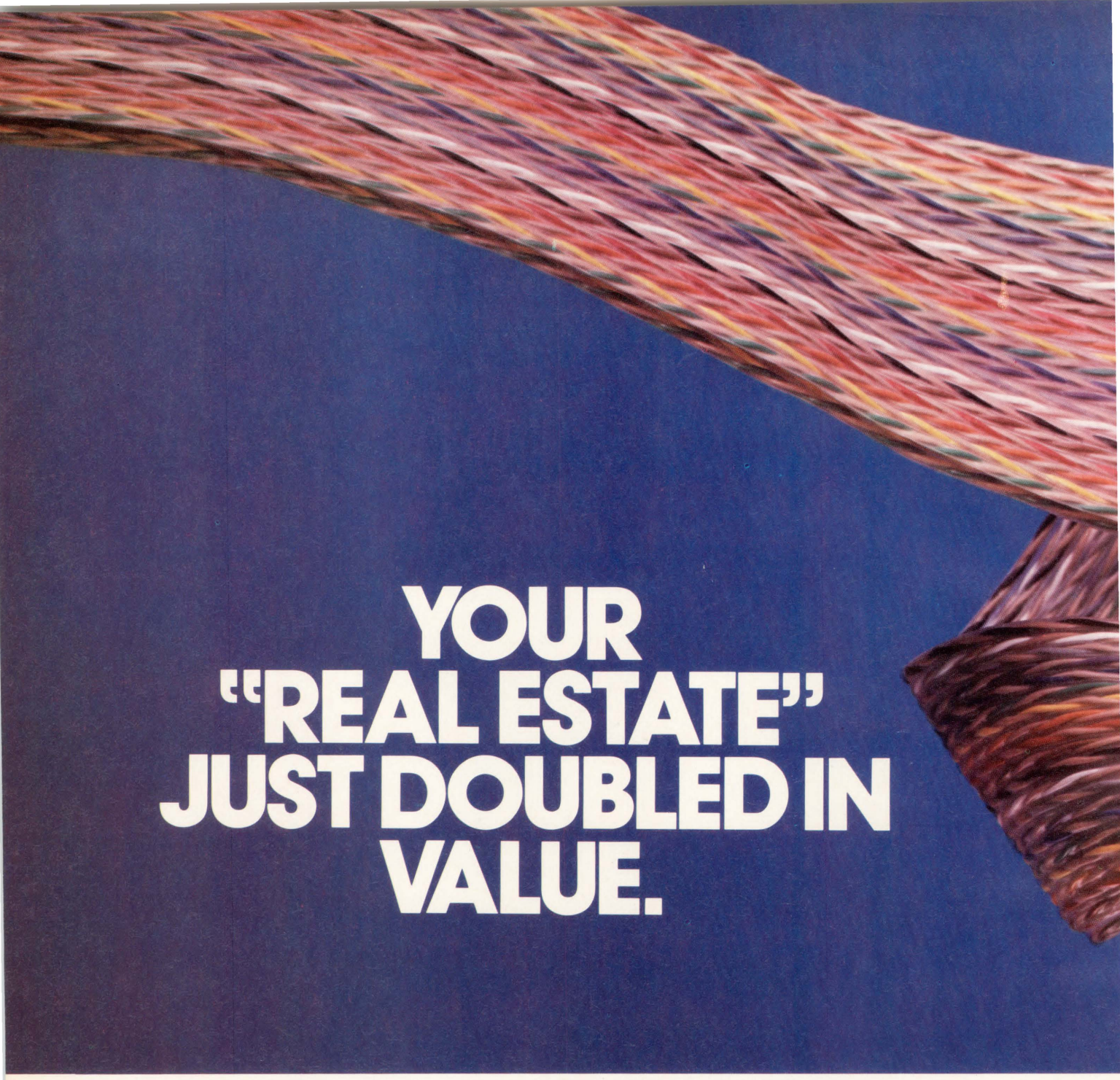
Compare for yourself. Of all the microcomputer-based multi-user systems available today, we know of only one which offers exactly what you need and should expect. Exceptional value and upward growth capability. The CompuStar™. A true price and performance leader!

INTERTEC DATA SYSTEMS®

2300 Broad River Rd. Columbia, SC 29210
(803) 798-9100 TWX: 810-666-2115

*Registered trademark of Digital Research, Inc.

CIRCLE 41 ON INQUIRY CARD



YOUR "REAL ESTATE" JUST DOUBLED IN VALUE.

Augat's new generation selective grounding (SG Series) IDC socket assembly and header system offers several important and unique customer advantages over conventional systems. For example, the SG Series:

- **Doubles I/O capacity of PC board "real estate"**
- **Eliminates paddleboards and labor-intensive soldering**
- **Reduces pin-outs by one-half**
- **Maximizes efficiency in wire and PC trace routing**
- **Cuts use of gold up to 75%**
- **Improves reliability**
- **Reduces average total applied system cost by 20%**

Also, the SG Series' unique design permits any combination of signal/ground assignments. This is accomplished through grounding common wires in each of the two cable lengths with a buss bar connected to one or more of the signal pin-out contacts. All other pin-out contacts are then available for I/O signal use.

The header is designed to be the new industry standard. It provides:



- **Improved strength and durability**
- **Better contact protection**
- **Stronger latch and eject mechanism**
- **16-position polarizing**
- **Cable shield disconnectable grounding**

The SG system is configured to be readily designed into most new and retrofit applications.

All of this is accomplished at substantial total applied cost savings for most customer requirements.

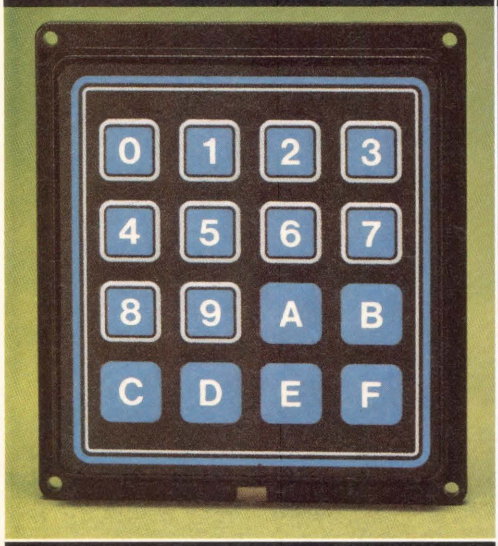
To get the full story on how your "real estate" can double in value, call your nearest Augat representative today, or contact Augat Inc., Interconnection Components Division, 33 Perry Avenue, P.O. Box 779, Attleboro, Massachusetts 02703.
Tel: (617) 222-2202, TWX: 710-39-0644.
In Europe, Augat SA-Fresnes, France.
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AUGAT® **Augat applies for your job.**

CIRCLE 42 ON INQUIRY CARD

GRAYHILL KEYBOARDS: DIFFERENT STROKES FOR DIFFERENT FOLKS

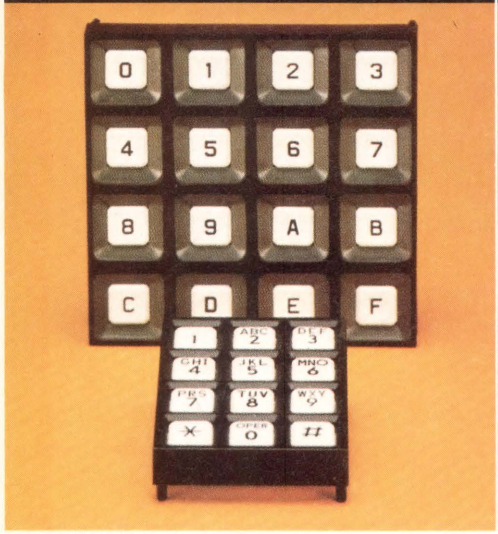
SERIES 88 A short stroke *sealed* keyboard with excellent audible and tactile feedback. Colorful standard or custom-made graphics integrates this keyboard into your front panel. Coded outputs and low bounce characteristics easily mate with logic circuitry. Circle No. 191



SERIES 82 Long stroke high profile, wiping contacts. 1, 2, 3 and 6 button modules can be arranged for your specific needs. SPST to 4PST circuitry under each button; also available with coded outputs. Circle No. 192



SERIES 83-84-86 Short stroke standard 3x4 and 4x4 keyboard configurations. Choice of ½ inch or ¾ inch button centers and post or flange mounting. Standard coded outputs—easily interfaces with logic circuitry. Excellent audible and tactile feedback. Circle No. 193



SYSTEM 87 Short stroke low profile, snap dome contact system provides tactile and audible feedback. Modular units—1 thru 6 buttons and 3x4 and 4x4 pads can provide any conceivable button arrangement. Circle No. 194



Your product is distinctive, and thus your keyboard needs are also likely to be unique. That's why Grayhill offers you four different keyboard families, with a host of options in each. We'll help you arrive at the keyboard solution that's most practical, attractive, and cost effective. Two of our four families—Series 83-84-86 and Series 88—are built around the popular 3 x 4 and 4 x 4 keyboard configuration; the other two—Series 82 and System 87—are modular, allowing you to create any unique keyboard arrangements.

Other features and options include:

- up to 3,000,000 operations per button
- standard or special coded outputs
- sealed or unsealed
- high or low profile
- short stroke or long stroke—dome or wiping contacts
- excellent audible and tactile feedback in dome contacts
- post, flange or PC mount
- ½″, 11/16″ or ¾″ button centers
- wide choice of legending modes
- color choices

For detailed information on Grayhill Keyboards, consult EEM, ask your local distributor, send for a copy of the Grayhill Keyboard Catalog or call us with your questions at (312) 354-1040.

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DATA CONVERSION

word to the Q-bus representing axis position. D-A conversion and servo driver amplifiers have 12-bit resolution with ±2-LSB gain error max and ±2-LSB dc offset error max.

A status register provides individual or master fault status, including individual R-D converter faults, reference oscillator/dc power fault, and master fault. Optional DDC-4181 (dual preamplifier) and -4182 (isolation transformer) facilitate scale impedance matching and slider signal buffering in inductosyn applications.

Circle 252 on Inquiry Card

Serial control units are preprogrammed

The SCU20, serial control unit (SCU), is a preprogrammed MK3873 single-chip microcomputer. It is a general purpose remote control data acquisition unit with 38 preprogrammed functions. It provides packaged software control for up to three, 8-bit parallel I/O ports, five timer/event counters, and an event-driven data logging capability for collecting up to 63 bytes of data from the ports for transmission to the host computer.

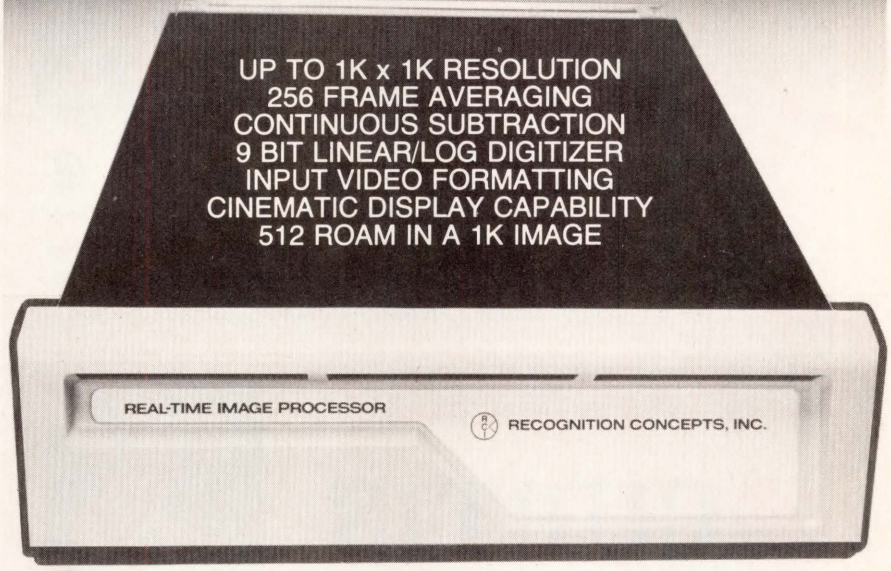
SCU20 is part of the SCU2 family of preprogrammed MK3873 8-bit microcomputers from Mostek Corp, 1215 W Crosby Rd, Carrollton, TX 75006, that are specifically designed as intelligent controllers to be connected through a serial data link. Communication takes place over an asynchronous half-duplex communications channel at 300, 1200, 2400, or 9600 baud. The baud rate is selected by a strapped option on the SCU.

The SCU2 network is a serial linked network of devices. All communications are via a common serial link using the SCU2 family communications protocol. In this way, a distributed control facility may be implemented from standard parts and controlled by the host computer via the serial link. The part can be used for both monitoring and control systems which require remote intelligence. It can be configured to provide different I/O and data acquisition functions through its 24 I/O pins. Intelligent functions such as Data Log and Event Counters allow different applications that will not burden the host system with constant update requirements. Packaged in a 40-pin plastic DIP, the SCU requires a single 5-V power source. It allows the user to network as many as 255 SCUs on a single communications channel.

Circle 253 on Inquiry Card

IMAGE PROCESSORS AT THE RIGHT PRICE

RCI Introduces The Ultra Reliable
TRAPIX SERIES
of Real-Time Image Processors



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CIRCLE 43 ON INQUIRY CARD

Low cost crystal clock oscillators for timing sources



Ideal for use as clock generators and timing sources where size, cost, performance and reliability are important.

- Circuit packaging techniques provide excellent reliability at competitive prices.
- Frequency range from 250KHz to 40 MHz
- Seated height only 0.200 inches
- Occupies only 0.815″×0.515″ on PC board
- Operated from +5 volt supply
- TTL compatible
- Frequency stability ±0.01% over their specified operating range
- Hermetically sealed, 100% leak tested to MIL-STD 883A and solvent resistant.

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(Formerly Bulova Electronics Division)

CIRCLE 44 ON INQUIRY CARD

CURTIS has RFI Power Line Filters for...

IMMEDIATE DELIVERY



• Comply with New FCC Noise Emission Limits • 3, 6 or 10 Amp Current Ratings • 100% Testing for Quality, Spec Compliance • UL Recognized, CSA Approved. VDE and SEV Approvals Pending • Application Engineering Assistance Available.

• Write or call for FREE Engineering Catalog with special "Application/Cost Effectiveness" and "Cross Reference" Guides, as well as "How to Select a Filter" section and complete product specifications.

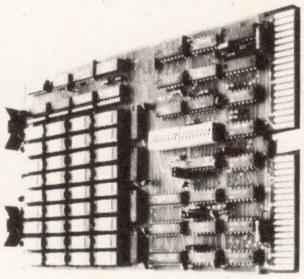


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Phone (414) 354-1500

4115

CIRCLE 45 ON INQUIRY CARD

STATE OF THE ART MEMORY SYSTEMS



256KB LSI 11/23® SINGLE DUAL WIDTH BOARD
The First and Only 256KB Memory on a Single Dual Board.

4 MEGABYTE ADDRESS FIELD — Most memories available for the DEC PDP 11/23 are only addressable to 256K bytes (18 address lines). The CI-1123 is addressable to 4 mega bytes (22 address lines) so there is no need to worry about obsolescence.

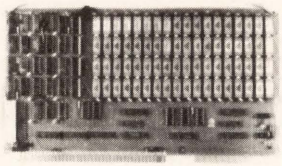
FAST ACCESS AND CYCLE TIME — With an access time of 270 NSEC and cycle time of 400 NSEC one is insured the best throughput on the PDP 11/23 system.

PARITY — The CI-1123 generates and checks parity for each byte of memory. Totally DEC compatible.

BATTERY BACKUP POWER CONSUMPTION — Power requirement for the module is only 1.2 AMP from the 5 volt supply. The CI-1123 is easily configured for battery back-up mode of operation requiring only 300MA from a single 5 V back-up supply for 256KB memory in the down state.

SINGLE QTY. PRICE: 32K x 18 **$575.** 128K x 18 **$1795**

512KB SINGLE BOARD MULTIBUS® MEMORY
State of the Art Multibus Memory Design.
First to Offer 512KB on One Board.



The CI-8086 module is compatible with both 8 or 16 bit Multibus Systems.

PARITY — The CI-8086 generates and checks even parity with selectable interrupt on parity error.

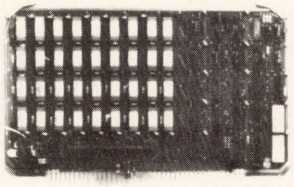
FAST ACCESS AND CYCLE TIME — Data access is 250 NSEC and cycle time is 375 NSEC.

16 MEGA BYTE ADDRESSING — The memory is addressable in 16K increments up to 16 mega bytes.

LOW POWER CONSUMPTION — Total power consumption is under 8 watts.

SINGLE QTY. PRICE: 128K x 9 **$795** 512K x 9 **$1995**

64K x 9 EXORCISER® I SINGLE BOARD MEMORY
For Exorciser I, Exorciser II and Rockwell System 65.



FAST ACCESS AND CYCLE TIME — Data access time is 225 NSEC and cycle time is 400 NSEC, allowing the unit to work as a static RAM at clock rates in excess of 1.5 mega hertz. For 2 mega hertz operation the board can be easily configured to utilize a cycle stealing refresh operation.

ADDRESSING — On-board memory select is available in 4K increments up to 64K words of memory on either the VUA or VXA control inputs.

PARITY — On board even parity with output jumper select to the system bus as a parity error or non-maskable interrupt.

Complete board power consumption is under 7 watts.

SINGLE QTY. PRICE: 64K x 9 **$575.**

Tested and burned-in. Full year warranty.

Chrislin Industries, Inc.
31312 Via Colinas · Westlake Village, CA 91361 · 213-991-2254

Multibus is a trademark of the Intel Corp. LSI II is a trademark of Digital Equipment Corp. EXORciser is a trademark of Motorola

CIRCLE 46 ON INQUIRY CARD

CONTROL & AUTOMATION

Industrial control computers reduce costs through fault tolerant techniques

Can't Fail™ Series 300 industrial control computers provide nonstop, error free operation even when a major hardware failure occurs. Incorporating fault tolerant technology, the system targets realtime control and monitoring applications where computer failure can have potentially catastrophic results.

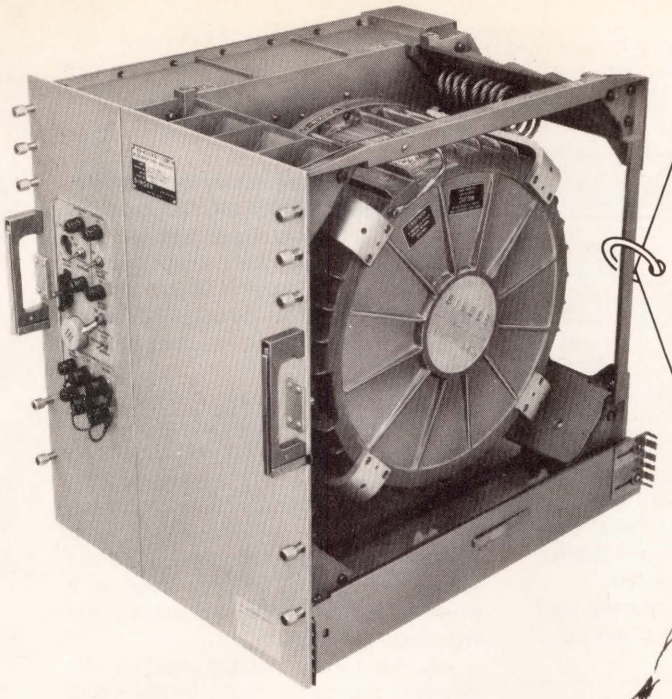
According to David W. Willoughby, president of August Systems, Inc, 2757 19th St SE, Salem, OR 97302, "With proper maintenance, the Series 300 system can deliver a mean time between failures (MTBF) that greatly exceeds the normal life of any industrial plant," and thus can eliminate or reduce costs resulting from computer malfunctions.

Using an approach to fault tolerance called Software Implemented Fault Tolerance, or "SIFT," the system handles fault tolerant functions with specialized software. Rather than just trying to avoid failures, it compensates for single component or major assembly failures while continuing operation. When a failure occurs, the system not only corrects all errors, but detects the failure and reports it to the operator. It is possible to repair failures or replace faulty modules without stopping the system.

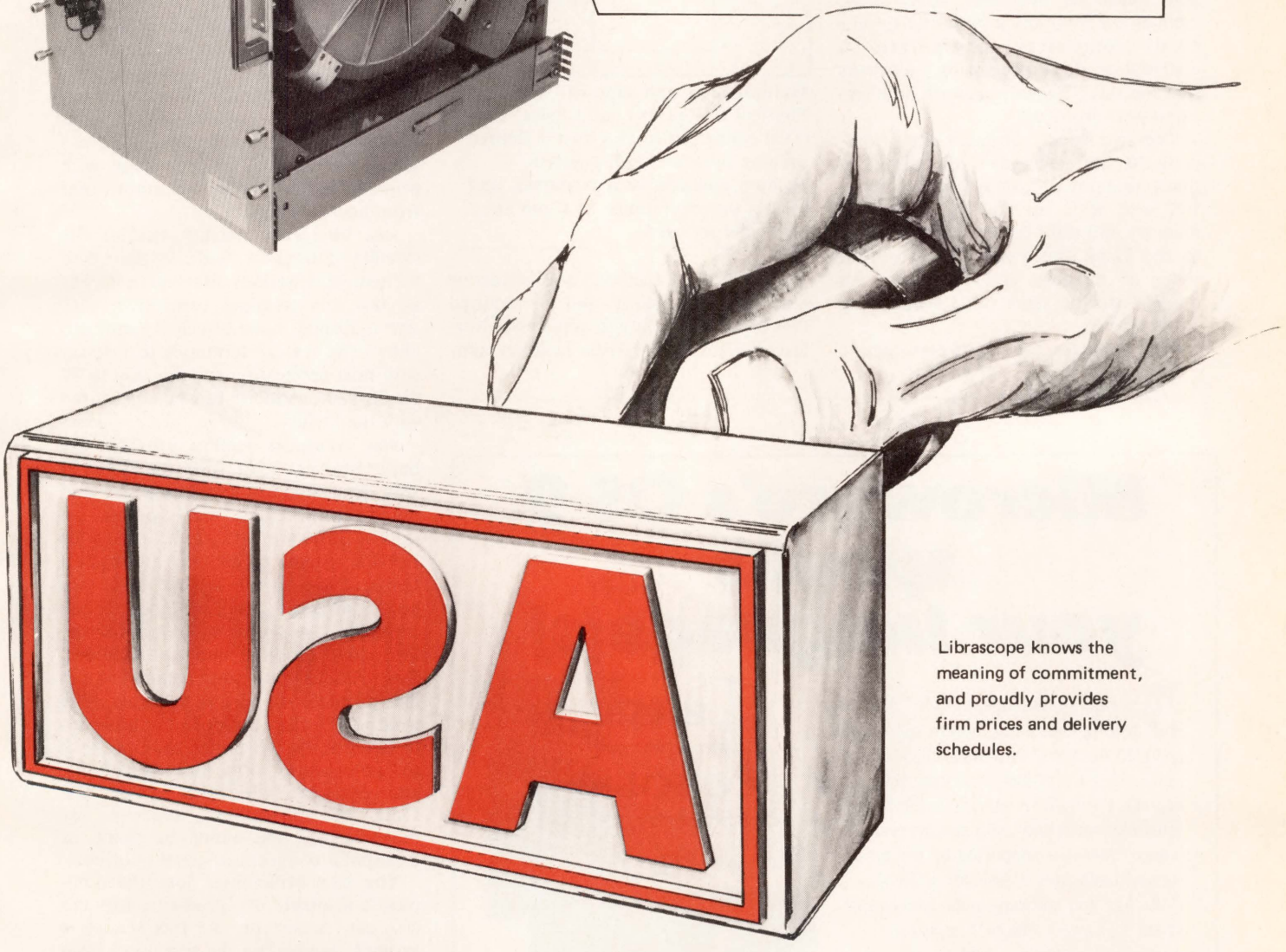
The system consists of three control computer modules based on the 16-bit 8086 microprocessor, process interface modules, and termination modules. Each control computer module (CCM) provides memory that expands from 32k bytes up to 1M byte, in any mix of RAM, ROM, or EPROM. Diskette drives and CRT terminal interfaces are provided. Process interface modules provide both digital and analog I/O capabilities, and extend fault tolerance to the process interface.

Three techniques are used within the system to achieve fault tolerance. Replication of hardware and software ensures functional availability. Voting procedures verify correct data, detect incorrect data, and arbitrate results. Read-only communication links isolate various system elements to prevent a malfunction from propagating throughout the system. A realtime task scheduler (RTTS) operating system performs all of the system's fault tolerance functions, and supplies utilities and drivers.

Circle 254 on Inquiry Card



LIBRASCOPE CAN DELIVER!



Librascope knows the meaning of commitment, and proudly provides firm prices and delivery schedules.

The **RD–433 Militarized Mass Memory** has been granted official **Approved for Service Use** (ASU) by the U.S. Navy. ASU means that the equipment is fully qualified, and assures the availability of logistics, software, and training support within the Navy. Extraordinarily reliable, the RD-433 is operational in the TACINTEL system aboard Naval ships at sea. TACINTEL is one of the largest communication systems in the Fleet Satellite Communications program. Other equally reliable Librascope Militarized Mass Memory Subsystems are used in the Navy's TRIDENT Integrated Radio Room and BQR-24 Sonar Systems, and on the U.S.C.G's WMEC-270 Cutter for command and control.

Librascope

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CIRCLE 47 ON INQUIRY CARD

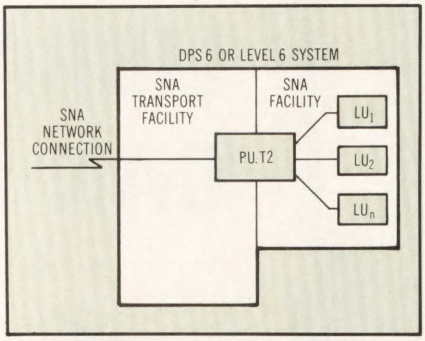
SOFTWARE

Software products enable DPS 6 and Level 6 computers to operate in SNA environment

A set of new communications software facilities, introduced by Honeywell Information Systems Inc, 200 Smith St, Waltham, MA 02154, enables the company's DPS 6 and Level 6 small computers to operate in distributed data processing networks that use IBM's systems network architecture (SNA) protocols.

The two small computer lines comprise 16 discrete models, that range in processing power from entry level 16-bit DPS 6/30 with up to 256k bytes of memory and eight communication lines, to the 32-bit DPS 6/96 with up to 16M bytes of memory and 112 lines. All models use the same GCOS 6 operating system.

The packages consist of SNA remote job entry (RJE) facility, SNA interactive terminal (3270) facility, and the required SNA transport facility to apply most low-level SNA protocols. These facilities complement the existing binary synchronous communications (BSC) RJE and terminal emulation products. Both SNA and BSC facilities make the small computers appear to an IBM network host as standard IBM controllers and devices. No additional programming is required at host or satellite.



Multiple logic unit support. Number of Physical Units (PUs) and Logical Units (LUs) connected to SNA host is limited only by DPS 6 or Level 6 system memory and processor resources, and by SNA protocol limits. SNA and SDLC protocols are used

SNA RJE facility allows the DPS 6 or Level 6 computers to emulate most functions of an IBM 3777-3 controller and attached devices in an SNA environment, and to establish a connection into its job entry subsystem. Job control and data streams are sent from the DPS 6 or Level 6 satellite to the host for processing, with printed reports or punched output sent from host to satellite.

SNA interactive facility enables the satellite computers with WST7200 and WST7801 workstations attached to appear as IBM 3274 terminal controllers with 3277/78 display units attached, and also allows the remote terminals to interact with host application systems. Up to 32 displays and printers can be configured with the facility.

SNA transport facility provides the basic Physical Unit (PU) functions of SNA, and supports SNA interactive and batch applications that operate on GCOS 6 software. It allows DPS 6 or Level 6 systems to connect as Physical Units Type 2 (PU.T2) to SNA (see accompanying Figure), while supporting common SNA protocol services for the interactive terminal and RJE facilities. Synchronous data link control (SDLC) line protocol support is provided. The transport facility supports multiple interactive and RJE facilities, multiple links to one or more hosts, multipoint links, and coexistence with other SNA devices. Half- or full-duplex, switched or nonswitched, and point to point or multipoint connections are supported.

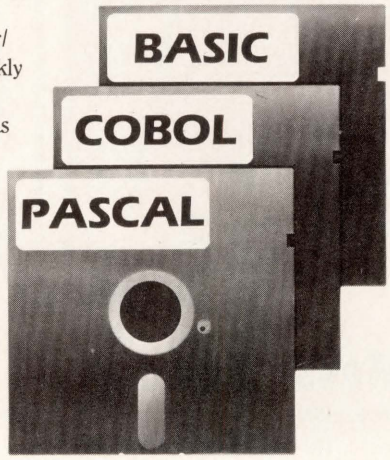
The SNA capabilities join the company's available BSC products. BSC and SNA can coexist on the DPS 6/Level 6 systems, facilitating the transition from BSC to SNA. The company stated that when IBM extends its SNA products to connect with X.25 private and public packet-switched networks, it will provide compatible connections via its DPS 6/Level 6 computers.

Available for demonstration in Oct 1981, these software products will be released during the second quarter 1982. Annual "primary" license fee for the transport facility is $270; for the interactive terminal facility $210; and for the RJE facility $315. All prices include basic software support.

Circle 255 on Inquiry Card

Microware's OS-9™ speaks your language(s)

Microware's multilingual OS-9™ Multiuser/Multitasking Operating System can be quickly installed on almost any 6809 microcomputer. This Unix*-like Operating System has become the industry standard due to its reliability, versatility, and supurb performance. And it is supported by the most-wanted languages: BASICØ9, COBOL, PASCAL; and software tools: Stylograph Word Processor, Macro Text Editor, Assembler, and more. Additional languages and applications programs are available for OS-9™ from many other software houses. For information on attractive OEM licensing plans, contact:



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(515) 279-8844 • TWX 910-520-2535

International Representatives: Australia, Semcon Microcomputers, Ltd., Sydney, Tel. 02 848-0800. England, Dialogue Marketing, Ltd., Tel. (06285) 29222,Tlx. 848080 MICRO G. Germany, Prodata, Schriesheim, Tel. 0 62 21 / 86 04 26, Tlx. 465008 WEISS D. South Africa, Eagle Electric Co. (Pty) Ltd., Capetown, Tel. 45-1421, Tlx. 57-20713 SA. Switzerland, Digicomp AG, Zurich, Tel. 01 66 12 13, Tlx. 812035 DIGI CH.

*Unix is a trademark of Bell Telephone Laboratories. BASICØ9 is a trademark of Motorola, OS-9 is a trademark of Motorola and Microware.

FAIRCHILD

A Schlumberger Company

Introducing our 93422A and 93L422A.

Our two new RAMs are the fastest 256x4-bit TTL RAMs in the world. Period.

Thanks to our Isoplanar process, we're talking about dramatic improvement in access times without having to increase power.

With our low-power RAM, you get 45 ns. Our regular-power RAM, 35.

And if you think our access times are good, just take a look at our power-dissipation specs. The 93422A gives you 775 mW commercial, 850 military. The 93L422A gives you 400 and 450.

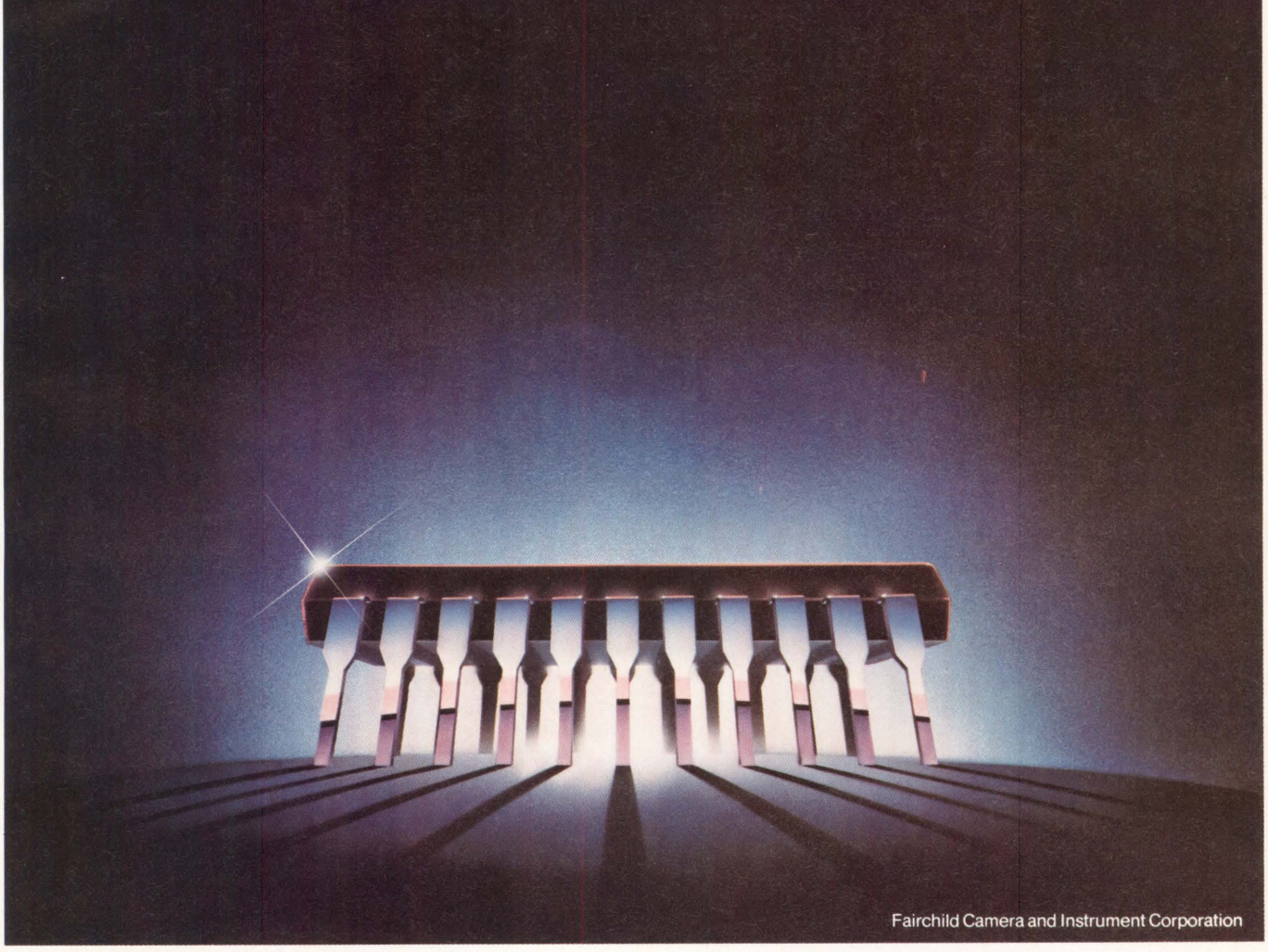
If that's not enough, both parts are ready for delivery right now.

So give us a call and we'll give you more information on our new RAMs.

They're the ones that are leading the pack.

For more information, call or write Fairchild about the 93422A and the 93L422A. Fairchild Bipolar Division, Drawer #7283, Mountain View, CA 94042. Telephone: (415) 962-3951. TWX: 910-379-6435.

France: Fairchild Camera & Instrument S.A., 121 Ave. d'Italie, 75013 Paris. Tel: 331 584 55 66. Telex: 0042 200614. **Italy:** Fairchild Semiconduttori S.P.A., Viale Corsica 7, 20133 Milano. Tel: 02 296001-5. Telex: 843-330522. **Germany:** Fairchild Camera & Instrument (Deutschland) GmbH, 8046 Garching Hochbruck, Daimlerstr. 15, Munchen. Tel: 089 320031. Telex: 52 4831 fair d. **England:** Fairchild Camera & Instrument (UK) Ltd., 230 High St., Potters Bar, Hertfordshire EN6 5BU. Tel: 0707 51111. Telex: 262835. **Sweden:** Fairchild Semiconductor AB, Svartengsgatan 6, S-11620 Stockholm. Tel: 8-449255. Telex: 17759. **Japan:** Fairchild Japan Corporation, Pola Bldg., 1-15-21 Shibuya, Shibuya-Ku, Tokyo 150. Tel: 03 400 8351. Telex: 2424173 (TFCTYO J). **Hong Kong:** Fairchild Semiconductor (HK) Ltd., 135 Hoi Bun Road, Kwun Tong, Kowloon. Tel: 3-440233. Telex: HX73531.



Fairchild Camera and Instrument Corporation

RAMs that really make tracks.

CIRCLE 49 ON INQUIRY CARD


ALTOS
BRAND
PROVEN VALUE
COMPUTER · SYSTEMS
PRODUCED IN THE HEART OF SILICON VALLEY, CALIFORNIA U.S.A.

BUMPER CROP

8-inch Winchester Multi-User Systems. Now In Volume.

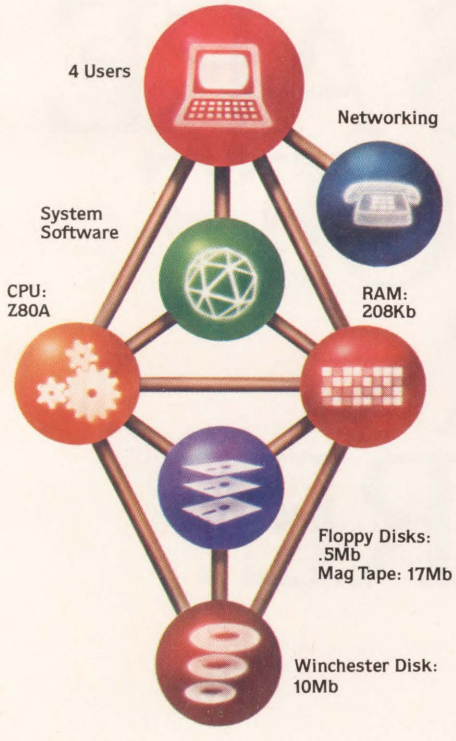
Altos is delivering the cream of the crop with their new 8-inch multi-user Winchester disk systems. They're freshly packed with the quality features you expect from Altos, and at a price you expect from Altos, too.

Pick from two fully integrated systems, each packaged in our new compact, stylish cabinet suitable for either rack mount or table top applications. You get 10 MBytes of reliable on-line storage in our 8-inch Winchester drives. Then for system back-up storage, you can select from either 8-inch, single sided floppy drives (ACS8000-10) or a ¼-inch magnetic tape drive (ACS8000-10/MTU). And for powerful performance, all of these Z80A® -based systems come complete with 208K of RAM and 1 programmable parallel and 6 RS232 serial ports, ready to support four users.

And Altos supports these systems with a broad software selection including the three industry standard operating systems—CP/M,® multi-user MP/M™ and OASIS. These operating systems support seven high level programming languages: BASIC, FORTRAN, COBOL, PASCAL, APL, PL/1 and C. Also available are comprehensive communications packages: ASYNC—Altos-to-Altos, BISYNC—Altos-to-mainframe and full networking with CP/NET.™ All are designed to run on a high speed 800 Kilobaud networking channel—standard with every system.

The ACS8000-10 Winchester systems join our growing family of field-proven products. In just four years more than 15,000 systems have been shipped.

Harvest your 8-inch Winchester system direct from the heart of Silicon Valley, California. Call or write today for specific product information and OEM pricing. Altos Computer Systems (European Head Office) 39 Champs-Elysees, 75008 Paris, France, (33-1) 225-9342, Telex 280888 MAISAL PARIS. (World Headquarters) 2360 Bering Drive, San Jose, CA 95131 U.S.A. (408) 946-6700, Telex 171562 ALTOS SNJ.



SYSTEMS PICTURED:
ACS8000-10 (10Mb HD + 1 floppy)
ACS8000-10/MTU (10Mb HD + DEI Mag Tape)



Packed with Fresh Ideas

ALTOS
COMPUTER SYSTEMS

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CIRCLE 50 ON INQUIRY CARD

DO YOU REALIZE WHY THE OTHER 32-BIT COMPUTER COMPANIES ARE SHOWING OFF THEIR HARDWARE?

PRESENTING MV/8000 SOFTWARE.

You're looking at the biggest library of 32-bit computer software in the business.

We point this out not to underplay the hardware of our total ECLIPSE MV/8000™ system, but because every industry observer we've heard is saying that software has become even more important than hardware.

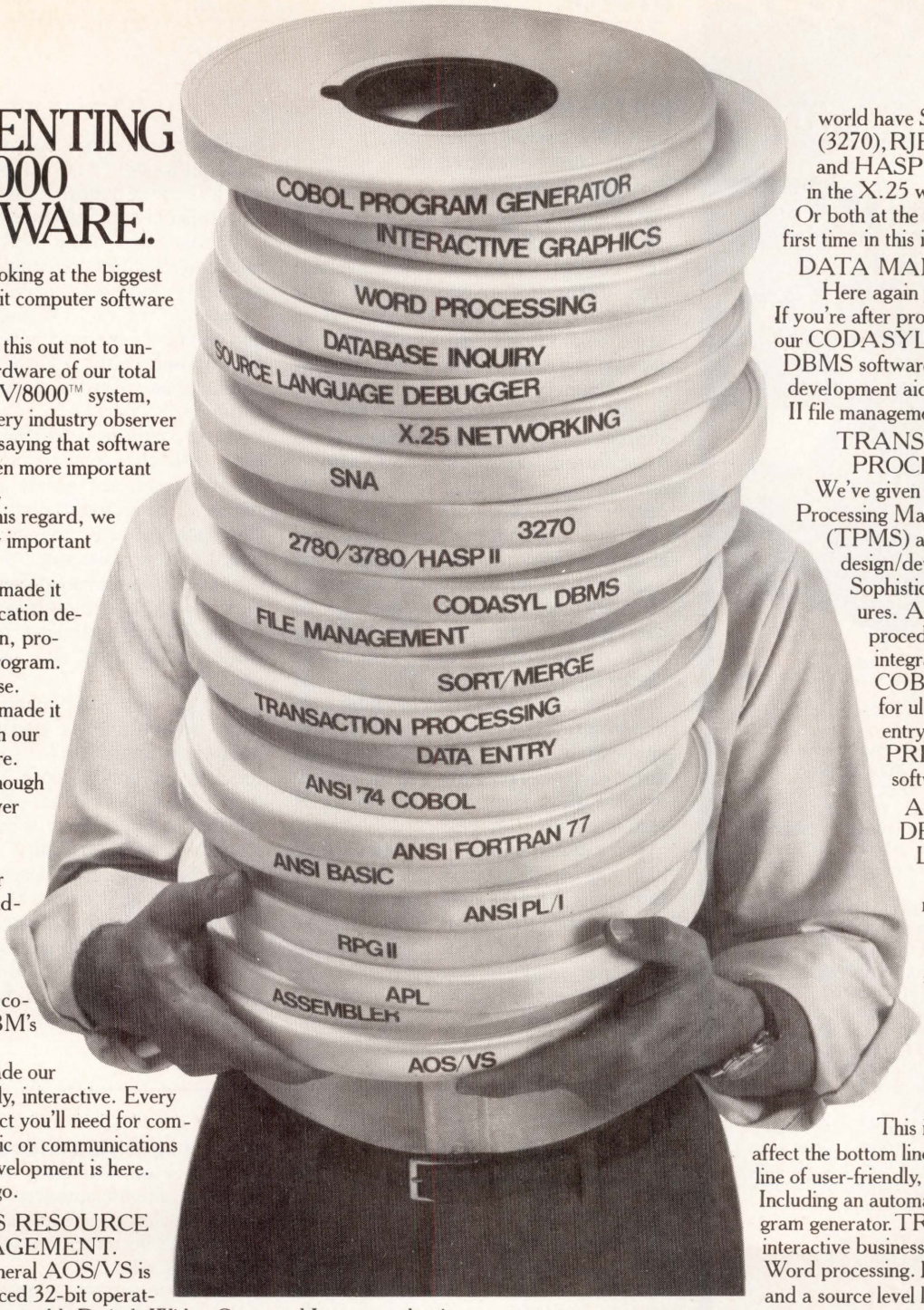
And in this regard, we have some very important software.

We have made it easier for application designers to design, programmers to program. And users to use.

We have made it compatible with our existing software. And flexible enough to work whatever way you like to work.

Wherever worldwide standards exist, we've followed them. (We're even peacefully coexisting with IBM's standards.)

We've made our software friendly, interactive. Every software product you'll need for commercial, scientific or communications applications development is here. And ready to go.



SYSTEMS RESOURCE MANAGEMENT.

Data General AOS/VS is the most advanced 32-bit operating system in the world. Period. With a Command Language that is the same for both batch and interactive processing. A HELP command. A Sysgen so interactive you don't even have to look at the documentation. Resource Usage Accounting and Security. Not added on. Built in.

COMMUNICATIONS.

Those who prefer working in the world of international standards can use our X.25 XODIAC™ networking. Those who want IBM's world have SNA, RCX70 (3270), RJE80 (2780/3780) and HASP II. And you can run in the X.25 world or SNA world. Or both at the same time. For the first time in this industry.

DATA MANAGEMENT.

Here again you have a choice. If you're after productivity, you have our CODASYL-compliant, DG/DBMS software with design and development aids. Or our INFOS® II file management software.

TRANSACTION PROCESSING.

We've given our Transaction Processing Management Software (TPMS) a strongly interactive design/development capability. Sophisticated security features. And simple recovery procedures. And it's fully integrated with both COBOL and PL/I. And for ultra-high-speed data entry, there's DATAPREP® key-to-disc software.

APPLICATIONS DEVELOPMENT LANGUAGES.

All seven of the most popular languages. All 32-bit. All to industry standards (where industry standards exist). All user-friendly, interactive.

PRODUCTIVITY AIDS.

This is where you can affect the bottom line most. With our full line of user-friendly, interactive aids. Including an automatic COBOL program generator. TRENDVIEW™ interactive business graphics software. Word processing. Database inquiry and a source level language debugger.

FINALLY. THE ECLIPSE MV/8000 HARDWARE.

If, after reading all this information about MV/8000 software you are disturbed to find nothing about the ECLIPSE MV/8000 systems hardware, write us at ISD Marketing Communications, Data General, 4400 Computer Drive, Westboro, MA 01580.

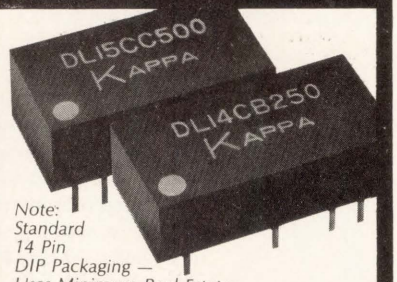
We will even include some very impressive four color photography of our 32-bit hardware. Just like you see on all the other pages of this publication.

DataGeneral

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CIRCLE 51 ON INQUIRY CARD

KAPPA
5-tap & 10-tap
Premium Quality
DIGITAL
DELAY
MODULES
for every computer & logic-circuit need.



Note:
Standard
14 Pin
DIP Packaging —
Uses Minimum Real Estate.
Sizes: (5 tap module) 0.400 max. × 0.800 max. × 0.275 max.*
(10 tap module) 0.400 max. × 0.800 max. × 0.325 max.*
*Height includes mounting standoffs.

DON'T SETTLE FOR LESS THAN THESE SPECS:
Risetime: 3ns typ. (4ns max.)
Resolution: 5 or 10 equally spaced taps; total delay from 25 to 1000ns.
Full Compatibility: with DTL/TTL, (see below)
Operating Temperature Range: 0°C to +70°C. (−55°C to +125°C Range is available on request.)

GET ALL THE ADVANTAGES OF MODERN HYBRID
(active/passive) design, in the most thoroughly tested delay modules in their class. TTL/DTL compatible.
ELECTRICAL CHARACTERISTICS
Supply Voltage (Vcc):
5.0V (±0.25V)
Logic 1 Input Current: 50μA max.
Logic 0 Input Current: −2mA max.
Logic 1 Voltage Output: 2.4V min.
Logic 0 Voltage Output: 0.4V max.
DRIVE CAPABILITIES
Logic 0 Output:
10 TTL Loads/Tap max.
20 TTL Loads/Unit max.
Logic 1 Output:
20 TTL Loads/Unit max.

TYPICAL APPLICATIONS INCLUDE:
micro-, mini, and mainframe computers; digital instrumentation for RAM, PROM, IC, and PLA testing; communications; and timing or radar, memory, and logic-array circuitry.

SEND FOR THESE DETAILED DATA SHEETS:
DL 14 Series (5 tap module)
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SOFTWARE

Software packages support packet communications in distributed networks

The latest addition to its Component Software Series, a high level data link control (HDLC) software package from Texas Instruments Inc, PO Box 202129, Dallas, TX 75220, provides HDLC communications support for the TMS9900 chip family, the TM990 series of microcomputer modules, and PM550 programmable controllers. The package supports packet communications in distributed networks and allows microprocessor-based nodes within a network to execute HDLC.

With bit-oriented HDLC interface among network hardware nodes, only single bits rather than entire characters are needed to separate the "packets" of data being transferred. The resulting rapid transmission of large data blocks (for example, up to 19.2k bits/s with the TM990/308 communications module) is an important factor in industrial control applications. An HDLC package can direct each primary station in the control of data flow from a maximum of 31 secondary stations.

HDLC data transfers are over a twisted-pair line or RS-232-C compatible interface; the required interface hardware depends on the application. TMS9900 microprocessors and TM990 microcomputer modules require a TM990/308 communications board and PM550 programmable controllers utilize a communication interface board. The hard-disc Multi-AMPL™ development systems use a Four Channel Communications Controller (FCCC) interface board.

The language being used for the application must be taken into account. An assembly language user must have Release 2.0 of the Realtime Executive, and a Pascal user must have Release 3.0 of Microprocessor Pascal software to communicate over the channels in HDLC software.

HDLC component software is compatible with the company's HDLC communications software, also newly released, for its DS990 computer systems. This package uses the FCCC interface board and supports HDLC over many independent communications lines in a network. The two software packages enable the system designer to implement HDLC in virtually any 990/9900-based network.

The current HDLC component software version allows users to specify nodes as primary and/or secondary and requires an approximate 20k-byte address space. A second version, to be released soon, allows specification of secondary only capability and will use about 3k-byte address space.

The package is available with a 4- to 6-week delivery time. Pricing depends on the storage medium: for FS990- and DSDD-floppy, and DS10-hard disc storage, $1500; for DS50 hard disc, $2000.

Circle 256 on Inquiry Card

Higher performance claimed for realtime multitasking OS

Developed for Intel MULTIBUS* single-board computers such as the iSBC* 86/12A, 86/05, and 88/40 (or custom designs), iRMX* 86 is a realtime multitasking operating system. Intel Corp, 5200 NE Elam Young Pkwy, Hillsboro, OR 97123, claims that the new operating system triples the performance of the original iRMX 86 system. New features have been implemented to reduce OEM design time in process control, intelligent terminals, office systems, data communications, and medical electronics applications.

Two system layers have been added to the OS. The extended I/O system (EIOS) layer performs automatic synchronization of read and write functions, and improves I/O performance by filling input buffers, keeping ahead of read requests, and writing output buffers at the proper opportunities. The EIOS layer enables users to take advantage of lower layers by interfacing directly with the basic I/O system and both the boot loader and application loader.

The second layer, a human interface layer, adds utilities for application programmers, end users, and custom programs. The system console is used to interface directly with iRMX 86 functions and application software. It provides a command line interpreter, useful with application packages as well as iRMX 86 utilities. Utilities are provided with the operating system to create, delete, copy, and rename data and directory files; to format devices; to submit a number of commands for execution in a batch mode; and to aid in the development and debugging of custom applications.

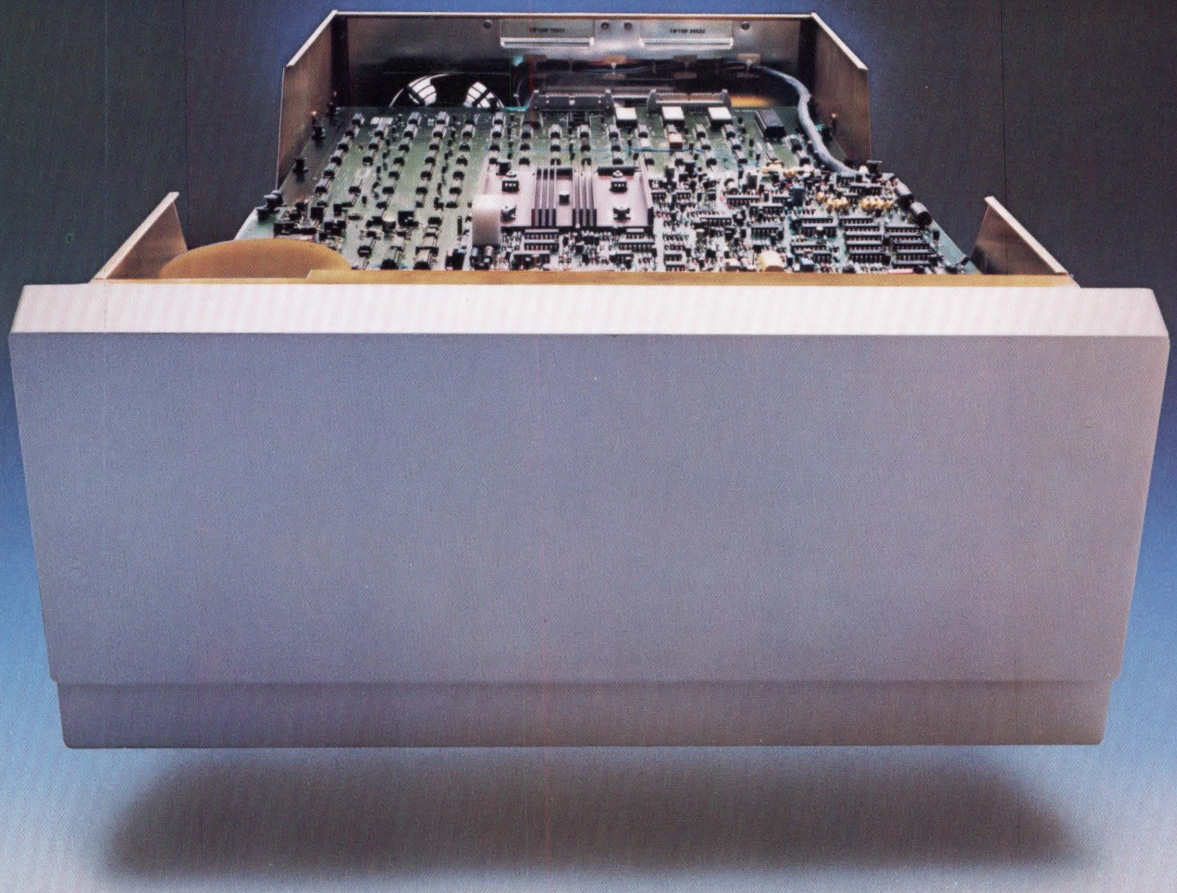
Although many applications will store the system in P/ROM, many will use

(continued on page 89)

*iSBC, iRMX and MULTIBUS are Intel trademarks

Century Data Systems
A Xerox Company

Drives for the 80's



Century achieves a new milestone in space.

The 160MB Marksman.

Planned evolution: a logical, cost-effective extension of a complete line of Marksman Winchester disk drives.

In just over two years, Century Data has boosted capacity of the Marksman eight-fold while cutting per-megabyte costs by a factor of three.

Like the 80MB model introduced at this year's NCC, the new Marksman 160 incorporates an improved head positioning concept developed in conjunction with the Xerox Advanced Development Laboratory.

A new torque motor and closed-loop servo system increases track density and improves data reliability. This motor boosts performance by 23 percent, yet fits in the same physical space as a stepper motor.

Remarkably easy to interface.

SMD or Marksman interfaces are standard.

It's also available with an embedded intelligent formatter

Continued on next page.

Century Data Systems
A Xerox Company

You finally found a supplier that can deliver 40MB Winchesters now.

Century Data Systems.

And what we'll deliver is disk drives. Not promises.

In fact, Marksman 20 or 40 MB Winchesters can be in your hands—in quantity—in a matter of weeks from your order. It takes that long for some other suppliers to send you a letter saying your order's in backlog.

Where time is of the essence, Century can go further. Not only will we deliver fast, we can ship intelligent Winchesters that can cut system integration time from months to days.

And don't think you have to pay a stiff price for a proven product that's available now. The 20 and 40MB Marksman drives go head-to-head on costs with similar-capacity disks of any size.

In fact, you won't find a better cost per MB. Anywhere. Your

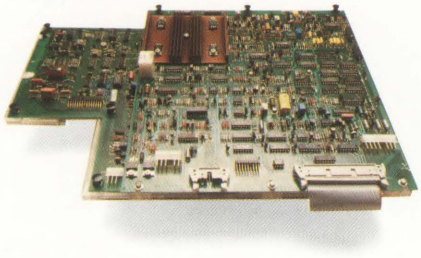


Century representative can tell you more.

Highlights:
Capacity: 20 and 40MB
Transfer rate: 960KBS
Avg. Seek Time: 65MS
Error rates:
Recoverable: <1 in 10^{10} bits
Nonrecoverable: <1 in 10^{13} bits
Positioning: <1 in 10^{6} seeks
MTBF: >8000 hours
MTTR: <30 minutes

Space

Continued from first page.



that typically enables systems integrators to interface to mini/micro bus structures in less than a week.

No more suffering through six months (or more) of in-house controller/formatter design time and the resultant hidden costs. Most of the difficult work is already done.

Century also provides the hardware application information and support to make your software job quick and inexpensive.

The result: Your systems can be sent to market that much faster for a competitive leg up.

Upward growth path... the story of the Century.

Start your customers out with 20 or 40MB drives. Solid, proven products available in OEM quantities now. Then integrate Marksman 80s and 160s as their storage needs grow.

With Century, an upper limit will be hard to find.

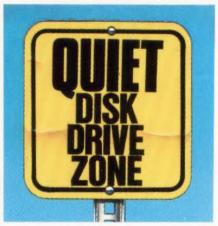
Cost/performance ideally suited to minis and micros.

Marksman 160 is a fixed Winchester disk with *significant* cost advantages. It will be available in various interfaces, with or without cabinets, embedded controller/formatter, and power supplies.

Call us now to reserve your evaluation unit.

Highlights:
Capacity: 160MB
Transfer rate: 1280KBS
Avg. seek time: 50MS
Error Rates:
Recoverable: <1 in 10^{10} bits
Nonrecoverable: <1 in 10^{13} bits
Positioning <1 in 10^{6} seeks
MTBF: >8000 hours
MTTR: <30 minutes

Century goes for a quiet drive in the office.



Computer systems were once confined to the computer room, along with all of the other devices that went with them. Tape drives, disk drives, printers and terminals were free to whirr, buzz, click and tap at will.

But this is the age of office automation, when computing equipment is liberated from the computer room for face-to-face contact with secretarial offices and even executive suites. The problem: the clicks and whirrs and buzzes have to be left behind.

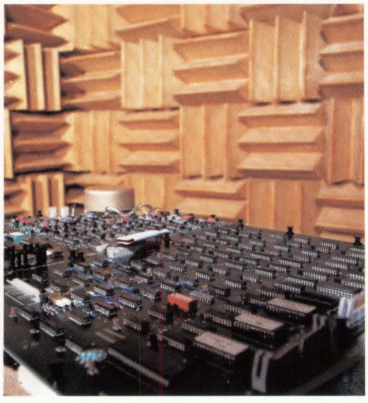
Dedicated DP systems. Word processing. CAD/CAM in engineering and design offices. Locally networked data bases. All of these applications give Century Data a mandate to design and manufacture Winchester disk drives that fit this new environment —not interfere with it.

At Century, special equipment and engineering expertise combine to bring quiet drives to the office.

Anechoic is Greek for "no echo." It's also the name for our chamber specifically designed to test noise levels in Winchesters. Pyramid shapes laid over insulating materials capture and absorb sound within the room.

Drive prototypes are placed within the anechoic chamber and put through their paces, while sound measuring devices read noise levels with laboratory accuracy. Drive-quietizing studies are made at the design stage—and verified on production units—enabling advances in engineering toward the quieter drive.

While one anechoic chamber is used for testing





and reducing sound levels from rapidly spinning disks and head-positioning mechanisms, another is used to measure emissions in the radio-frequency spectrum. With this precise way to measure RF noise, we can improve our designs and reduce these emissions.

Century's anechoic chambers are just two devices among many to help us make the better Winchester. It's all part of an ongoing multi-million dollar investment in the future of disk data storage.

For the full Story of the Century...
just check the information you want, and we'll send it to you right away.

☐ Marksman: 160MB ☐ Trident: 300MB
☐ Marksman: 80MB ☐ Trident: 200MB
☐ Marksman: 40MB ☐ Trident: 80MB
☐ Marksman: 20MB ☐ Trident: 50MB

☐ I would like an evaluation unit for one of the Marksman Winchester or Trident Removable-Pack Disk Drives listed above. Someone will contact me to make arrangements as soon as possible.

Send to: Century Data Systems, 1270 N. Kraemer Blvd., Anaheim, CA 92806.

Please enclose your business card. CD

Century Data Systems
A Xerox Company

Century Data Systems
1270 N. Kraemer Blvd.
Anaheim, CA 92806

North American Headquarters
(714) 632-7500



The million dollar clean room.

At Century Data, one particle of dirt a fraction of the diameter of human hair is considered absolute filth. So we spent a million dollars to make sure that kind of mess never contaminates our Winchesters.

First, we built a clean room with two sections, each wrapped in a bubble of intensively filtered air flowing in a laminar pattern. In one section, we degrease disk, head and enclosure materials with freon.



In the main clean room section, the actual assembly takes place on six clean benches. Each engulfed in its own additional bubble of even cleaner air.

Our next task: making sure the people who assemble the Winchesters are clean enough. A surgical nurse would be too dirty.

The only people that get into our clean room are professionals who have just been scrubbed and scoured. They wear surgical clothing, masks, hoods and special shoes. And they don't eat, chew gum, drink coffee, smoke or even sweat.

The total effect duplicates the zero-error concept of manufacturing used in manned space flight.

Without that kind of clean on top of clean, you just can't be confident of a sealed disk drive. Especially when you think of that flying head, 80 atoms of air away from the whirling high-speed disk. Let just the tiniest fragment of a particle in, and it will not only threaten the data's integrity, it could even damage the components.

Impressive as it is, our million dollar clean room is just one of many quality assurances that goes into a Century drive.

We've put another three million dollars into the most sophisticated automatic test equipment, fixtures and software you'll find anywhere.

It's all part of a continuous commitment to quality like nothing else you'll find in the industry.

Century ready with SMD drives.



Some manufacturers can keep you waiting a year or more for removable-pack disk drives. Especially if you need SMD interface capabilities.

But not Century Data.

Our removable-pack Trident drives are available now. With SMD interfaces, as well as DTL/TTL's. From our 50 and 80 megabyte table-top and rack-mountable models to our 300 megabyte free standing models.

Tridents are dependable, too. Our fully enclosed, specially sealed contamination control system protects your data's integrity, even during preventative maintenance.

We could go on. But the big plus is that you can get our Tridents. Fast. Which means you can start pushing sales out the door. Instead of stalling your customers with some story about how long it takes to get a drive with SMD.

So don't risk your sales by waiting around for a disk drive. Talk to Century about Tridents, today. And get your systems up, running and out to your customer.

SOFTWARE

either the bootstrap loader or the application loader to load part or all of an iRMX 86 application into system memory from both the supported iSBC device controllers, or from custom devices. MULTIBUS device controllers for standard 8″ (20-cm) discs and mini-floppies, Winchester and SMD disc drives, and bubble memory systems are supported with loaders and file access mechanisms. The operating system is supplied on either single- or double-density diskettes for use on Intel's MDS development systems.

Circle 257 on Inquiry Card

Optimizing Pascal compiler surpasses FORTRAN's performance

Pascal-2, an optimizing compiler, produces optimized object code that compares in size and speed with code produced by DEC's FORTRAN IV-Plus compiler. Resulting code is both smaller and faster than interpretive or threaded languages (BASIC-Plus, BASIC-Plus-2, UCSD Pascal), as demonstrated by several benchmarks. (See illustration.)

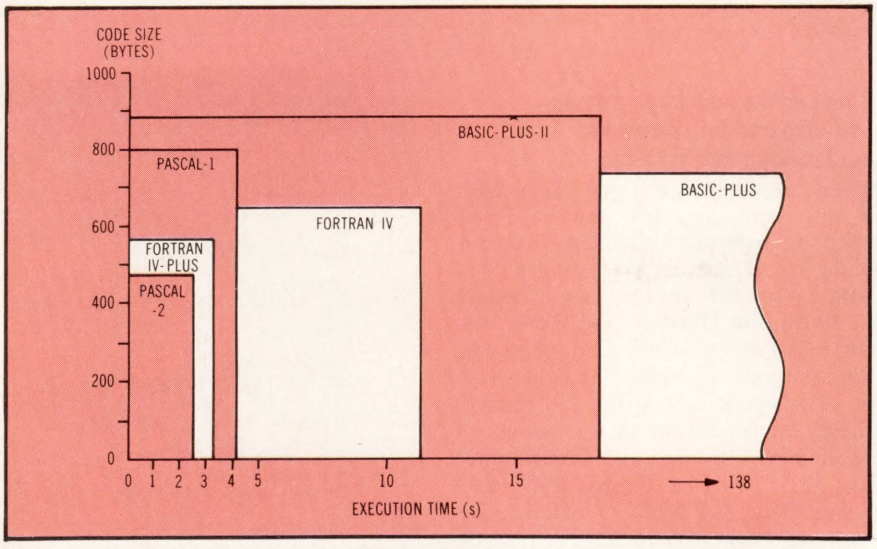
The compiler, developed by Oregon Software, 2340 SW Canyon Rd, Portland, OR 92701, produces code that is typically 20% to 40% smaller and twice as fast as that produced by their single-pass Pascal-1 compiler. It runs on all Digital Equipment Corp PDP-11 processors, including LSI and VAX in compatibility mode, under RSTS/E (V6C and V7); RSX-11 (11M, 11D, 11M-Plus, IAS, VMS/AME); and RT-11 (V3, V4, SJ, XM, TSX-Plus).

Written in Pascal and designed using structured methods, the compiler includes internal overflow and consistency checks. Itself portable, the compiler is designed to produce portable programs and has been implemented on a Honeywell computer; it is currently being prepared for several other 16-bit and 32-bit processors, including the Motorola 68000.

Optimizations include global register allocation, constant folding, dead code elimination, short circuit evaluation, expression targeting, array index simplification, branch tail merging, and common subexpression elimination. Operating in five phases, the compiler uses virtual memory techniques to handle large programs. A source language debugger helps to uncover errors that cannot be caught at compilation time; a profiler helps to identify those sections of the program where a small amount of programmer effort may have large payoffs in execution efficiency. Utilities include a cross-referencer for procedures in a program; a cross referencer for variables in a program; program formatters; a text formatter; a character string package; and a MACRO-11 interface package.

The package conforms closely to the draft proposed Pascal standard; it requires the extended instruction set, 28k of memory, and 500 blocks of disc storage to execute. Standard Pascal is fully supported, and a number of extensions allow programmer convenience, I/O flexibility, and low level operations. A compilation switch disables extended language features, allowing only elements of the ISO standard language to be compiled.

Circle 258 on Inquiry Card



Pascal-2 compiler, developed by Oregon Software, produces code that compares favorably in size and speed with that produced by DEC'S FORTRAN IV PLUS. Results of various compilers running Quicksort Benchmark on a PDP-11/45 are plotted to compare code size and execution speed

CAD software automates interactive design and drafting functions

The ITS-10, an advanced 3-D CAD software package, serves the needs of multiple design disciplines. The 3-dimensional design and drafting package, developed by CAD-Systems AG of Basel, Switzerland, merges with MARC, MARC/NASTRAN, and MENTAT programs, also available from MARC Software International, Inc, 525 University Ave, Suite 810, Palo Alto, CA 94301, to supply a powerful design and analysis environment. Targeted at automotive, aerospace, industrial, architectural, and mechanical design applications, the software minimizes cost/design workstation because it uses existing 32-bit computers.

The package's ability to handle solids modeling coupled with a powerful CAD data base provide the tools needed to model complex objects. Geometrically, objects or models are described by areas, volumes, holes, and voids combined into 3-dimensional object representations.

Analysis capability is added by interfacing ITS-10 to finite element software. MENTAT, the finite element modeling package, interfaces directly to the CAD data base, and provides all pre- and post-processing for finite element analysis software.

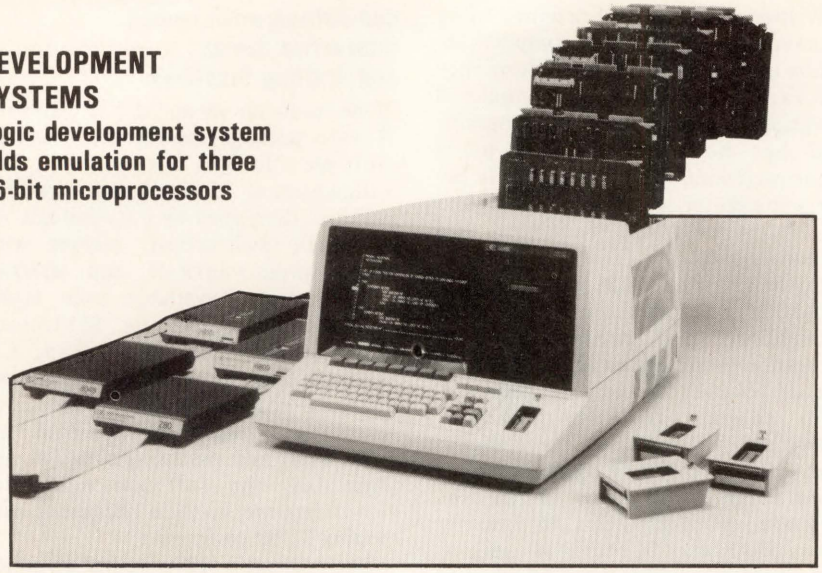
Running on Prime, DEC, VAX, and IBM computers, the software is claimed to shorten design cycles and result in productivity increases of from 2 to 20 times. Key features are visual displays and English dialog to assist designers at each stage of model creation. The system automatically checks for model accuracy and geometric completeness, and allows proven designs to be modified easily. Users can input and interact through cursor, digitizing tablet, or keyboard, and can use Cartesian, polar, or spherical coordinate reference systems.

Display capabilities include zoom to magnify or reduce display window size, choice of virtually any 3-D view of the model being designed, and selective display of any part of the model. In addition, the system maintains a working display of the model being designed or edited that can be windowed to any part of the work area for design interaction. Drafting capabilities include line drawing variables that allow thickness and color of lines to be altered, a variety of line types and point symbols, and a selection of shading choices. Dimensioning variables include unit of measurement and degree of precision, as well as character font types for supplementary figures.

Circle 259 on Inquiry Card

DEVELOPMENT SYSTEMS

Logic development system adds emulation for three 16-bit microprocessors



New 16-bit emulator and Pascal compiler modules. Model 64000 logic development system combines up to six development stations that share hard disc memory and printer

Capabilities of its model 64000 logic development system (*Computer Design,* Nov 1979, p 168) have been extended by Hewlett-Packard Co, 1507 Page Mill Rd, Palo Alto, CA 94304, to include emulation of three 16-bit microprocessors. Processors and emulation system model numbers are: Intel 8086/8088, model 64220A; Zilog Z8001/Z8002, model 64230A; and Motorola 68000s, model 64240A.

At the same time, Pascal/64000 compilers for the 8086/8088 and Z8001/Z8002 16-bit, and for the 6809 8-bit microprocessors, have been added to the list of system options. All models can be added to new or existing development systems.

The emulation technique checks hardware and software operations in the interim stages of developing microprocessor based products. Operating speeds of the new emulators are 8 MHz (8086); 5 MHz (8088); 6 MHz (Z8000); and 8 MHz (68000). Operating mode of each emulator is functionally transparent to the target system. Up to 128k bytes of emulation memory can be ordered separately.

Generated program code is first stored in emulation memory. As it meets designer defined specifications, it is block-transferred into the target system memory. Both target and emulator memories function as one during emulation; a user defined memory map specifies which memory space is operational for given code blocks.

An emulation monitor provides register reads, single-stepping, displaying, or modifying target memory, as well as initiating runs from a given address. The monitor can be modified for each application. Separate buses for emulation and operating systems avert intrusions by the operating system during emulation runs.

Pascal/64000 is a modification of Pascal block structured high level language, with extensions and restrictions for optimal implementation in the development system. The 3-pass compilation process runs at 300 to 700 lines/min. The Pascal modules can be linked with assembler language modules.

Prices (U.S.) for the 64220A 8086/8088, 64230A Z8001/Z8002, and 64240A 68000 emulator systems range from $7900 to $23,500. The Pascal/64000 compilers for the 8086/8088 and Z8000 are priced at $3000, and for the 6809, $2000. Deliveries are 8 to 12 weeks.

Circle 260 on Inquiry Card

Development package allows use of personal computers as development systems

The OKI series 40 CMOS single-chip microcomputers can now be developed on personal computers that run under C//M, such as the Apple II Plus with a Microsoft Z80 card, TRS-80 Model II, North Star Horizon, and Heath H89. Series 40 4-bit CMOS microcomputers can have programs developed on either ISIS^{R} or CP/M operating systems. To convert these microcomputers to series 40 development systems, OKI Semiconductor, 1333 Lawrence Expwy, Suite 401, Santa Clara, CA 95051, is offering the MPSP-C package. The package consists of MPB-201/203 boards, a CP/M 8″ disc containing a series 40 cross assembler,

(continued on page 95)

Intelligent Systems

COLOR COMMUNICATES BETTER

For a demonstration, contact one of our Factory Representatives

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AK: Anchorage 907/276-5616

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PAR Associates
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Southwest

Computer Peripheral Sales
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BFA Corporation
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TX (El Paso): 915/542-1762

USDATA Engineering
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AR, OK: Broken Arrow, OK 918/252-9646

Midwest

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Resource Data Systems
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Digital Systems Sales, Inc.
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Southeast

W.A. Brown Instruments, Inc.
GA, LA, NC, SC, TN, AL, FL: Atlanta, GA 404/455-1035; Mandeville, LA 504/626-9701; Durham, NC 919/683-1580; Columbia, SC 803/798-8070; Oak Ridge, TN 615/482-5761; Huntsville, AL 205/883-8660; Orlando, FL 305/425-5505; Ft. Lauderdale, FL 305/776-4800; Melbourne, FL 305/723-0766; Ft. Walton Beach, FL 904/243-3189

Intron Corp.
VA, DC, MD: Springfield, VA 703/569-1502

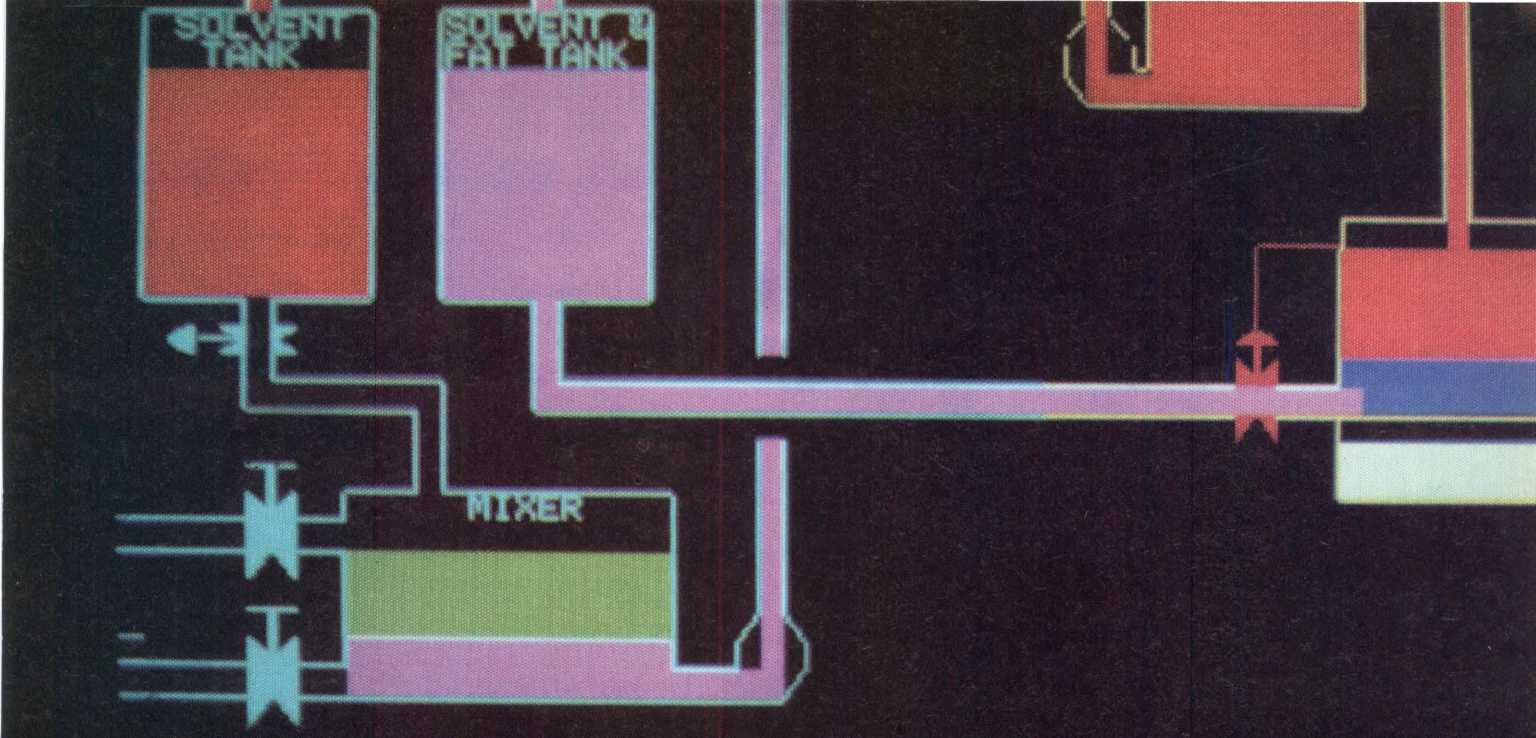
Northeast

J&J Associates, Inc.
MA, ME, NH, VT, RI: Winchester, MA 617/729-5770; Springfield, MA 413/737-6624; Goshen, CT 203/624-7800

NACO Electronics Corp.
NY (Excluding Metro NY/L.I.): North Syracuse, NY 315/699-2651; Cicero, NY 315/672-3751; Fairport, NY 716/223-4490; Utica, NY 315/733-1801

Technical Marketing Associates, Inc.
NJ (No.), **NY** (Metro/L.I.): Hackensack, NJ 201/646-9222

Miller & Dietz Co.
PA (E.), **NJ** (So.), **DE:** Malvern, PA 215/647-7373



The Intelligent Systems' guarantee:

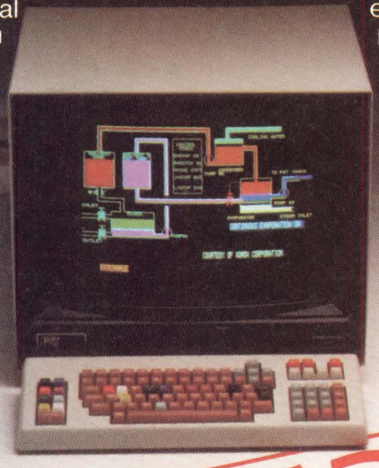
If you don't like it, we'll buy it back.

Leave it to Intelligent Systems to come up with an offer like this. After all, we were the first firm to deliver over 20,000 color graphics desktop computers and display terminals. *Now, we're the first to deliver a factory-direct, money-back guarantee!* And the 8001-G color graphics terminal we are offering is the standard in the process control industry.

Here's how it works: Buy a single-evaluation unit before December 31, 1981, at our special price of $2,120, cash with your order. Use it for 30 days. If the performance, reliability and quality of this unit does not convince you this is the very best value in color graphics terminals, simply return it. And we'll return the purchase price of the unit. It's that simple. If you wish to return the unit, your only cost will be transportation charges to and from Norcross, Georgia.

However, we're convinced you'll keep it. Because once you see the difference that color can make—especially at this price—you'll be convinced too. Because the 8001-G includes features such as an Executive size 19" CRT (not 13"), an eight foreground color, eight background color display... 160 x 192 graphics ... 128 standard characters... 80 characters per line by 48 line format... and an ASCII, 101-key keyboard. Plus, every terminal can easily and inexpensively be upgraded to a full-featured desktop computer!

So, it's sound business to make Intelligent Systems your low-cost one-stop source for color graphics. You'll be joining companies like Johnson Controls, Taylor Instruments, Leeds & Northrup, E.I. duPont, Corning Glass and Chevron Research. For the name of your nearest Intelligent Systems representative, call 800-241-9699. Talk to the world leader in low-cost color graphics. After all, with a money-back guarantee, we take the risk out of your evaluation!



$2120 Keyboard Included

Money Back Guarantee

Intelligent Systems

COLOR COMMUNICATES BETTER

225 Technology Park/Atlanta
Norcross, Georgia 30092
Phone 404/449-5961· TWX 810-766-1581

U.S. domestic price.
Unretouched photos of screens.
Money-back offer expires 12/31/81.
Application courtesy of the Xomox Corporation.

CIRCLE 53 ON INQUIRY CARD

SHUGART
A REVOLUT

Choice.

If you've been looking at disk drives for desktop systems, you may have thought you had only one choice: take it or leave it.

Not any more. Now you can get everything you need from a single source. And get the added convenience of doing business with one company.

Say you want a reliable, entry-level drive, but cost is critical. The ideal choice? Our SA400, the original Minifloppy.™

Or maybe you need more capacity, but you don't want to give up low cost. Try our double-sided Minifloppy, the SA450.

Then too, you may want to move up to even higher speeds and capacities — up to a megabyte — in a Minifloppy-size package. For that, choose our 96-TPI SA410 single-sided or SA460 double-sided drives.

But what if your desktop system demands the high performance and reliability of a

INTRODUCES IONARY IDEA.

Winchester? Then specify our new 5.25-inch fixed disk drive, the SA600. It's got ten times the throughput of a floppy, and capacities from 3.33 to 10 megabytes. And by teaming it with a Minifloppy, you get duplicate file backup too.

Now *that's* choice. Which means you get just the right combination of cost and capacity for your application. And in the desktop market, that's a revolutionary idea.

To find out more about your desktop alternatives, contact Shugart Associates, 475 Oakmead Parkway, Sunnyvale, CA 94086. Telephone (408) 733-0100. Or Hamilton/Avnet, authorized distributor.

Shugart

Right from the very start.



Sales and Service: Sunnyvale CA, Costa Mesa CA, Minneapolis MN, Richardson TX, Framingham MA, Landing NJ, Atlanta GA, Toronto Ontario, Paris France, Munich Germany.

Come and see us at COMDEX, Booth #1504

CIRCLE 54 ON INQUIRY CARD

54 dB.
Put up or shut up.

The Gauntlet Is Down

Can any dot matrix computer printer match the **INFOSCRIBE 1000**? Its sound level in normal, continuous operation is only 54 dBA. By independent sound laboratory test.*

That's right, 54 dBA. Like a group office where paper shuffling and throat clearing are making most of the noise.

As far as we're concerned, **INFOSCRIBE 1000** is the quietest serial matrix impact printer on the market.

Compare with the typical matrix printer that can sound like a blender full of ball bearings, and you have the Number One reason why your next printer will be an **INFOSCRIBE 1000**.

Even printers advertised at 56dB are a **full 2 dB higher** than ours. (Remember, every 3 dB up doubles the noise.)

A New Generation Printer

If **INFOSCRIBE 1000's** purr were its only benefit, you should still buy it for the sanity of your office staff. But it happens that **INFOSCRIBE 1000** is also the most feature-packed, the most beautiful, and the most economical printer in its class.

Graphics Galore

INFOSCRIBE 1000 doesn't print characters only. Under software control it produces charts, diagrams, graphs, signs, anything within a vertical and horizontal resolution of 70 dots per inch. Now we're talking about a capability that can enhance management presentations, sales reports, even technical documents.

Format Flexibility

INFOSCRIBE 1000 can produce data processing quality characters at 10, 12, or 16.5 characters per inch, or correspondence quality characters at 10. You also get subscripts and superscripts in any selected pitch, double-wide printing, true lower case descenders, and true underlining.

In addition to two different character sets stored in the printer, a third character set can be downloaded from the host computer. This offers a total of 288 different characters that can be selected on a character-by-character basis.

Gratifying Throughput

There's more to **INFOSCRIBE 1000's** speed than a nominal 200 characters per second. High-speed paper movement with vertical tabbing, plus bidirectional printing with logic seeking in both directions gets a lot of work out of the machine. And that's equivalent to having a faster computer.

Unmatched Elegance

It's almost unfair that **INFOSCRIBE 1000** is also the industry's best looking matrix printer. Slim, sleek, graceful, it makes those machines with the visible viscera look like remnants of early experimental days at Menlo Park. **INFOSCRIBE 1000** is completely enclosed, sealing dirt out while sealing noise in. Its controls use membrane switches, so not even knobs or buttons break its sculptured exterior.

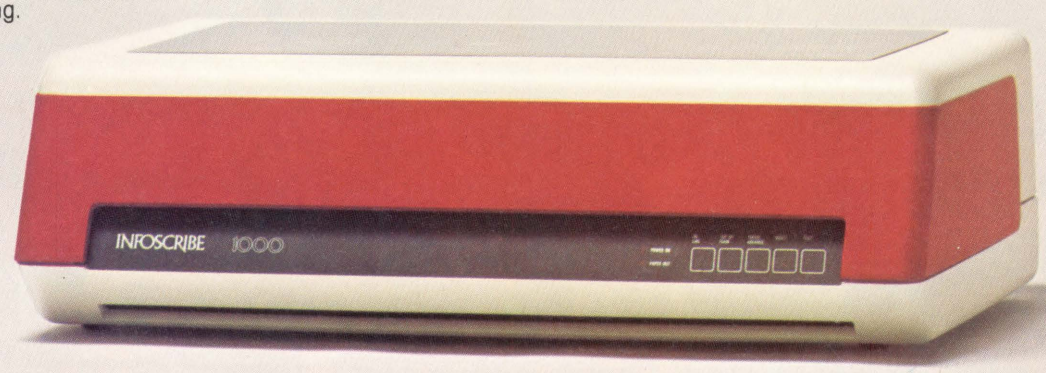
Demand the INFOSCRIBE 1000

Is there a single reason why you should have any printer but the **INFOSCRIBE 1000**? At $1,825 in singletons (substantially less in OEM quantities), **INFOSCRIBE 1000** becomes mandatory for your system.

Insist on it from your system specialists. And if you are buying a first-time computer, no matter what make, ask for the printer that is setting a new standard: **INFOSCRIBE 1000**.

Get full details from your nearest Infoscribe distributor/representative. Or talk to your computer dealer. If he doesn't handle Infoscribe yet, he will.

**Contact Infoscribe for an abstract of the independent testing laboratory report.*



INFOSCRIBE™

QUIETLY AUTHORITATIVE

Headquarters and Factory: Infoscribe, Inc., 2720 S. Croddy Way, Santa Ana, California 92704. Distributor/Representatives: CA, HI (714) 964-4722 or (415) 948-8961; WA, OR, MT, ID, AK (206) 455-4922; CO, UT, WY (303) 371-4140 or (801) 292-8145; MN, ND, SD (612) 992-7011; TX, OK, AR, LA (214) 661-9633, (713) 681-0200, (918) 252-9646 or (512) 454-3579; IA, IL, IN, WI (312) 298-4830 or (414) 351-6123; MI, OH, WV, KY, West PA (313) 227-7067, (216) 398-9200, (412) 922-5110, (513) 435-7684, (616) 363-9839; East PA, DE, South NJ (215) 542-9876; North NJ, Metro NY (201) 569-4200; MA, VT, ME, CT, RI, NH (617) 729-5770, (413) 737-6624 or (203) 624-7800; Upstate NY (315) 699-2651, (315) 732-1801 or (716) 223-4490; DC, MS, AL, GA, TN, VA, MD, NC, SC, FL (301) 424-1416, (404) 451-2293, (205) 536-9990, (919) 824-2196 (305) 851-5710, (305) 746-2996; France 334-30-20; United Kingdom (063-33) 69162; Norway (02) 259150; Australia (61-2) 29-3753.

Overseas Distributor Inquiries Welcome

CIRCLE 55 ON INQUIRY CARD

DEVELOPMENT SYSTEMS

download and execution software, and user manuals.

The MPB-201 PCB emulates series 40 microcomputer operation. It plugs directly into the user's series 40 socket. Programs can be executed from P/ROM or onboard RAM. The MPB-203 is a serial interface to an MPB-201. It contains the logic necessary for interfacing the MPB-201 signals to an EIA interface, a 20-mA interface, or a TTL compatible interface for serial ASCII communications. The MPB-203 also contains a socket for EPROMs, allowing direct programming without an external P/ROM programmer. The chip can then be verified on a remote board prior to mask design.

Circle 261 on Inquiry Card

Portable development system supports lab and field environments

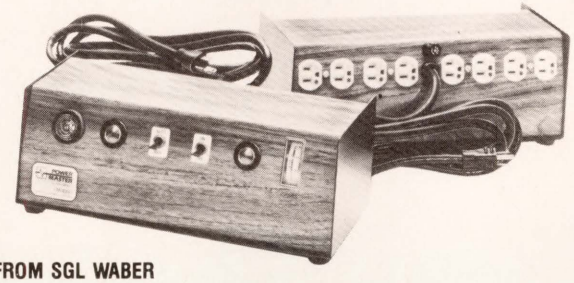
Designed to create a separate environment for in-circuit emulation, ICEBOX™ is a portable development system with its own self-contained operating system and library of test routines in ROM. In a standalone configuration the device will operate when linked to a dumb terminal, and for more complex applications, when interfaced through a high speed link to a PDP-11, Intellec™ 800, or Intellec™ series II model 220. The device allows field testers and development engineers to "speak" to each other in the same language. From Relational Memory Systems (RELMS) Inc, 1180 Mira Loma Way, Sunnyvale, CA 94086, the first ICEBOX model is the Z80-ICE. Software exists for other microprocessors, and versions will be released when hardware is available.

Featuring 4-MHz operation and zero wait states in all modes for 8- and 16-bit emulators, the product is available as an 8-bit version with a minimum 64k bytes of emulation memory, and a 16-bit version with a minimum of 256k bytes of emulation memory. Optional packages such as EDIT, Z80, ASM, and Z8000 ASM come with a 256KBE board.

A flexible I/O structure supports IEEE, RS-232-C serial line printer and Centronics parallel formats, and SDLC, HDLC, and bisync protocols. Data communications control programs for Intellec and PDP-11 permit utilization of PDP-11 and Intellec file systems and support remote diagnostics and updating.

Circle 262 on Inquiry Card

NEW CLEAN POWER.



NEW FROM SGL WABER

The electricity that powers your sensitive mini and micro computer systems is "polluted." Filled with voltage spikes and noise interference that can cause information loss, incorrect readings and premature circuit failure.

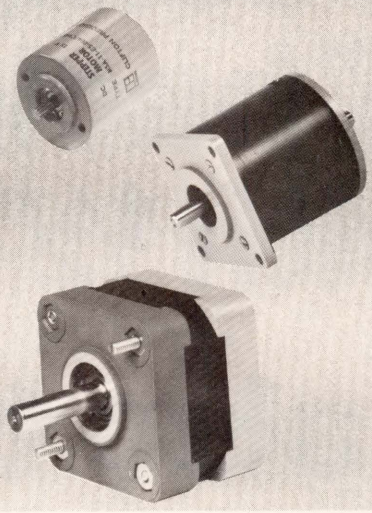
Protect your data and equipment. Purify your power with a new Power Master ® Line Monitor Power Conditioner. Ready to use — just plug in. Free 20 page catalog featuring 8 models.

POWER MASTER by SGL WABER Line Monitor Power Conditioner

SGL WABER Electric/A division of SGL Industries, Inc.
300 Harvard Avenue/Westville, NJ 08093/(609) 456-5400

CIRCLE 56 ON INQUIRY CARD

HIGH PERFORMANCE PM AND VR
STEPPER MOTORS
WITH CERAMIC, ALNICO OR RARE EARTH MAGNETS



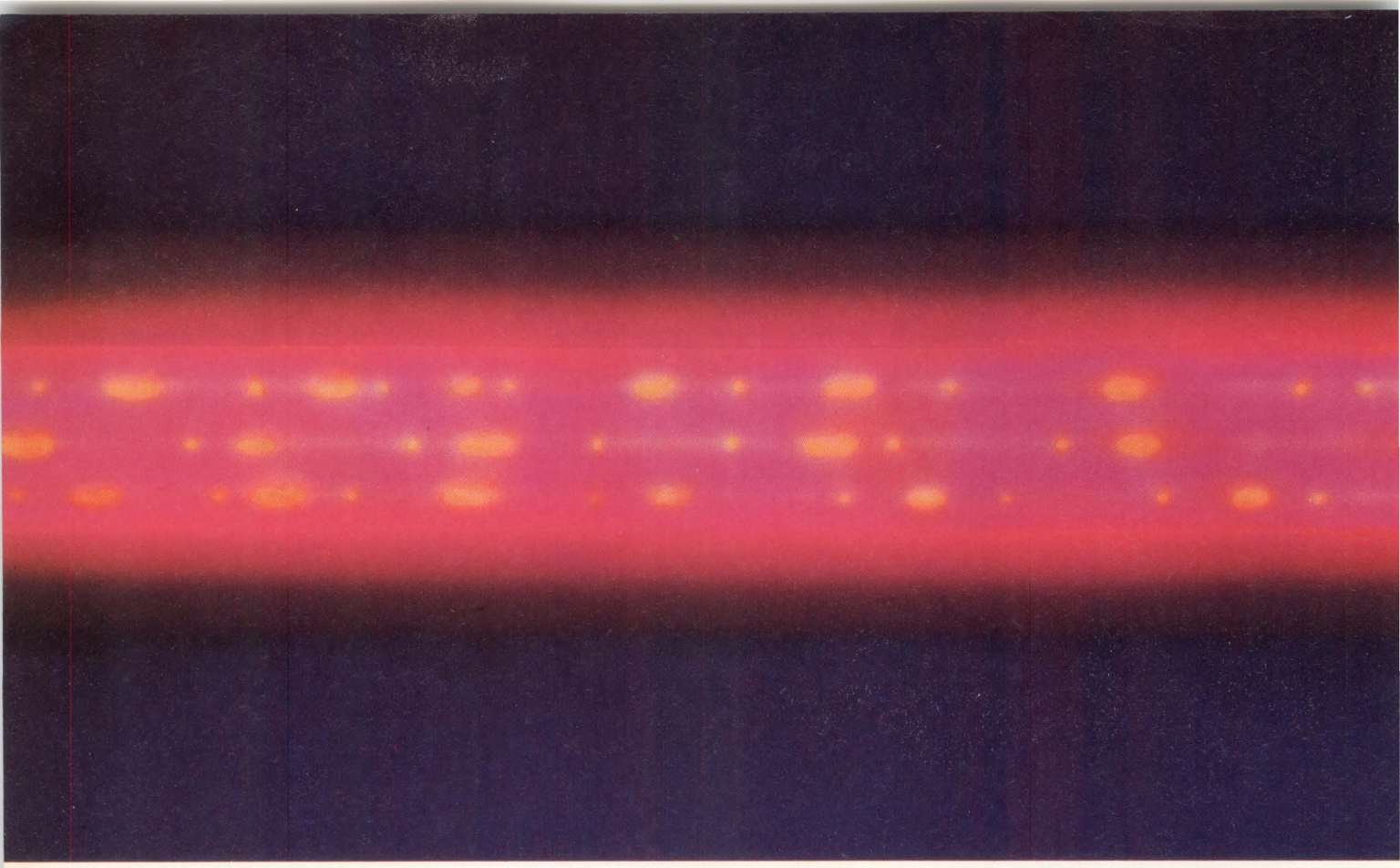
Computer age reliability...

Motors range from size 8 to 42 with step angles 1.8°, 1.875°, 3.6°, 7.5°, 15°, 30°, 45° and 90°. Write or call for complete catalog. Call (215) 622-1000.

Litton CLIFTON PRECISION®

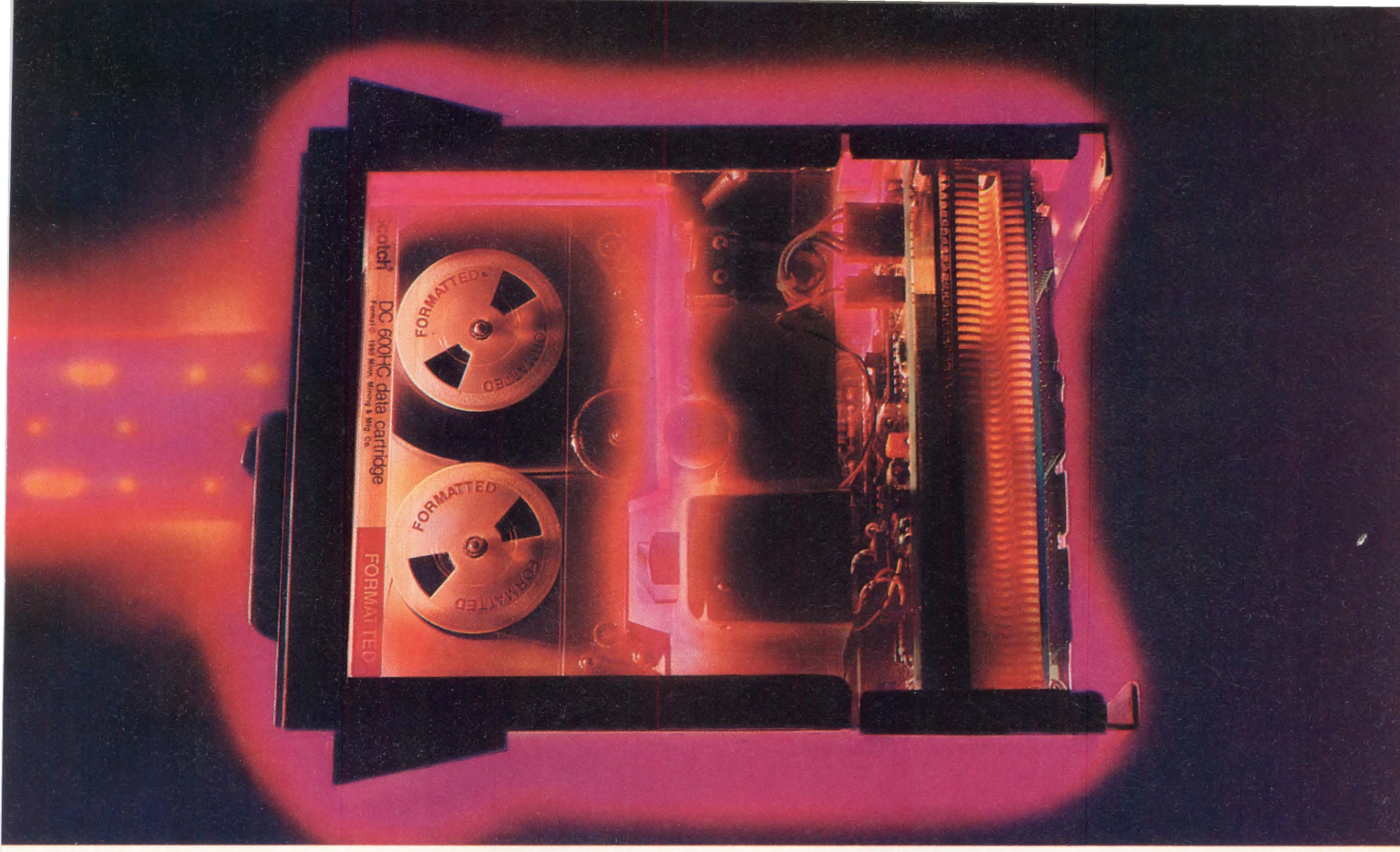
MARPLE AT BROADWAY * CLIFTON HEIGHTS, PA. 19018

CIRCLE 57 ON INQUIRY CARD



It takes real nerve to compare our ¼" back-up system with ½" drives.

It also takes 67 megabytes.



HCD-75: so much for so little.

Presenting the only ¼" cartridge back-up system that'll go head to head with ½-inchers in the critical 30-70 Mbyte range.

The reason is simple. The 3M Brand HCD-75 Data Cartridge Drive System gives you 67 Mbyte per cartridge formatted. No other cartridge drive gives you so much capacity.

There's nothing medium about the medium, either. Each Scotch® DC 600HC cartridge is pre-recorded with permanent forward/reverse-reading block keys. They give you block-addressable storage. You get compact recording on all 16 tracks, with a density of 10,000 frpi, without rewinds.

The HCD-75 system, including drive and controller, is about one-fifth the size of a ½" tape drive. You don't have to put back-up and I/O plans on the back burner because of size constraints.

Interchange for the better.

Cartridges interchange quickly and easily. Tape-to-head alignment is ensured by a special sub-routine. It automatically aligns the read-write head and stepper motor controller to the tape edge each and every time the operator puts a cartridge in the system.

There's brain to this back-up, too. First, all its functions are handled through its controller. And second, there's minimal host involvement, so host time can be freed up for more critical functions.

All the reliability without high cost.

You can run one HCD-75 drive off the controller, or two, or three, or four. You still get all the reliability of the high-priced drives. The HCD-75 runs self-test routines to ensure proper operation. It gives you sophisticated error messages when faults are detected.

Advanced error-detection/correction routines keep working to deliver extremely low error rates. The micro-processor controls the drive functions; so potentiometer adjustments are a thing of the past.

Back-ups to go.

The total system—drive, controller, pre-formatted Scotch DC 600HC cartridges—is available to OEMs now. One at a time, or in evaluation quantities, you can take delivery on this reasonable, reliable, truly high-capacity alternative to ½" drives.

As close as your phone.

In fact, if you have been holding off on a back-up decision—or even if you haven't—make us put our back-up where our mouth is.

Call toll-free 800-328-1300. (In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division. We'll give you the name of the 3M HCD-75 representative in your area. He's just waiting for the chance to show off his latest, greatest back-up.

Or write us at Building 223-5N, 3M Center, St. Paul, MN 55144.

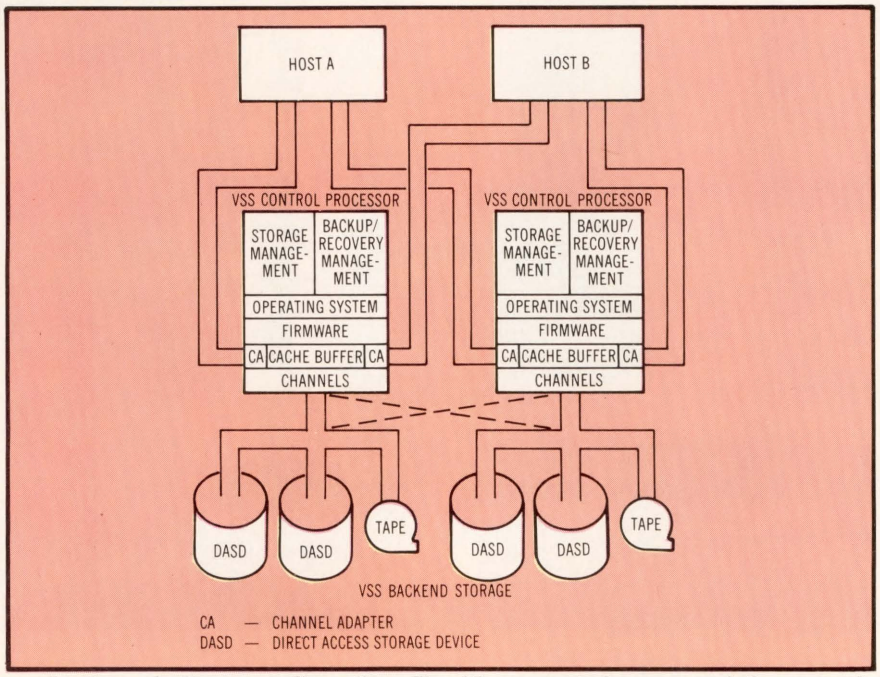
3M hears you...

3M

CIRCLE 58 ON INQUIRY CARD

MEMORY SYSTEMS

Virtual storage system reduces data storage costs, speeds access functions, increases disc utilization



VSS hardware/software configuration. Should one control processor fail, a second can take over total system work load with no function loss. Fully-configured VSS supports 300 concurrently open data sets at sustained data rate exceeding 4.8M bytes/s. Average access time is less than 1.5 ms

Intended for the large scale sequential access data processing environment, STC 7000 Virtual Storage System (VSS) is an intelligent attachment to IBM and IBM-compatible computers using the multiple virtual storage (MVS) operating system. Host buffering is not required. The VSS is designed to reduce costs of data storage and management, and to speed up the data access function. Under development for nearly three years by Storage Technology Corp, 2270 S 88th St, Louisville, CO 80027, VSS will be available in the United States and Canada during July, 1982 and introduced in Europe later this year.

VSS includes two System/370-compatible CPUs, each having 1M to 8M bytes of solid state cache memory; two to eight microprocessor-based channel adapters; disc and tape control units; backend disc and tape drives; and data management software (see accompanying Figure). Data management is handled "outboard" in the VSS control processor (VCP), similar to the function of a communications frontend processor, thereby relieving the host computer of housekeeping tasks.

Double utilization of existing disc drives is possible, one of the most immediate benefits of the VSS concept, according to the manufacturer. VSS automatically allocates space for sequential data regardless of data set size, permitting nearly 100% disc utilization; average utilization in existing systems compares typically as low as 45 to 50%.

VSS also uses a data compression algorithm that further reduces the size of stored data by 25%. All data transferred from host to VSS are automatically compressed by suppressing redundant characters. The system further reblocks the compressed data into full track frames. Combined with the data compression feature, these features are said to allow an average 25k of user data to be stored in each direct access storage device (DASD). The system dynamically allocates disc space at the track level, with no pre-allocation or wasted space.

Three complementary techniques handle the problem of data backup. Cyclic backup, an automatic time-driven mechanism, incrementally backs up only data that have changed since the beginning of the current cycle. It copies the changed data to tape at user defined intervals. Data journaling, a second alternative, causes the system to dynamically write tape image copies of backend disc tracks as they are written to system storage. A third choice is shadow recording, selectable at the data set level.

(continued on page 102)

Where to buy an Intel memory system:

Alliance Electronics, Inc.
Albuquerque, New Mexico
(505) 292-3360

Almac/Stroum Electronics
Seattle, Washington
(206) 763-2300

Arrow Electronics
Farmingdale, New York
(516) 694-6800

Component Specialities, Inc.
Houston, Texas
(713) 771-7237

Hamilton/Avnet Electronics
Culver City, California
(213) 558-2193

Harvey Electronics
Woodbury, New York
(516) 921-8920

Industrial Components
Minneapolis, Minnesota
(612) 831-2666

L. A. Varah
Hamilton, Ontario
Canada
(416) 561-9311

Measurement Technology Sales Corp.
Greatneck, New York
(516) 482-3500

Mesa
Gaithersburg, Maryland
(301) 948-4350

Pioneer/Cleveland
Cleveland, Ohio
(216) 587-3600

Pioneer/Dayton
Dayton, Ohio
(513) 236-9900

Pioneer/Washington
Gaithersburg, Maryland
(301) 948-0710

Wyle Distribution Group
El Segundo, California
(213) 322-3826

Zentronics
Mississauga, Ontario
Canada
(416) 676-9000

Listed are the main offices of our distributor network. For your local office, please consult the Yellow Pages.

In case of memory loss, it's nice to have a number you can call.

Any independent supplier can save you a bundle on add-in/on memories for your DEC minicomputer.

But now, there's one that offers you more than a bargain, a handshake and a piece of paper good for a year.

It's us, Intel.

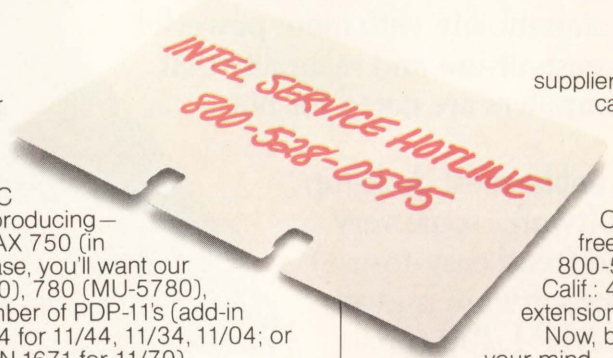
Need on-site memory service and installation? With our boards, it's always available. By convenient fixed-cost contracts.

They offer you the sensible luxury of a qualified technician who can isolate the problem in a hurry. Whether you're in mid Manhattan or outer Osawatomie (we have over 50 service centers in the United States, Canada and Europe).

If you have your own service force, we can stand behind them, too.

With off-the-shelf replacement boards (90% are on their way to you within 24 hours). Flat rates that won't catch your budget by surprise.

And whatever else we can do to keep your DEC system producing – be it a VAX 750 (in which case, you'll want our MU-5750), 780 (MU-5780), or a number of PDP-11's (add-in CM-5044 for 11/44, 11/34, 11/04; or add-on IN-1671 for 11/70).



And when you need our attention at the snap of a finger, just pick up our toll-free service hot line.

That's a lot of support. Exactly what you'd expect from a company with ten years of reliable leadership in the business. Providing Data General as well as DEC memories. Plus standard and custom memory systems.

To find out how to expand your VAX, PDP or Eclipse system – with a memory supplier you know you can depend on – contact your local Intel distributor (listed at left). Or call our toll-free sales number: 800-538-1876 (In Calif.: 408-734-8102, extension 506).

Now, before it slips your mind.

DEC, PDP and VAX are trademarks of Digital Equipment Corp., ECLIPSE is a trademark of Data General Corp.

Europe: Intel International, Brussels, Belgium
Japan: Intel Japan, Tokyo. United States and Canadian distributors: Alliance, Almac/Stroum, Arrow Electronics, Avnet Electronics, Component Specialties, Hamilton/Avnet, Hamilton/Electro Sales, Harvey, Industrial Components, Pioneer, L. A. Varah, Wyle Distribution Group, Zentronics.

intel® delivers solutions

CIRCLE 59 ON INQUIRY CARD

IF YOU WANT TO START YOUR OWN COMPUTER COMPANY, YOU NOW HAVE THE COMPUTER TO START WITH.

The entrepreneurial spirit runs rampant in the computer industry. In fact, it's come to our attention that a significant number of the technical/engineering types have some thoughts of starting their own company.

So we have come out with a computer for them. And for those entrepreneurs within companies who are in a hurry to get their hot new project to market in a hurry.

It's called the MPT/100.

As you can see, the MPT/100 computer is small enough to fit in whatever corner you set aside for furthering your own ambitions.

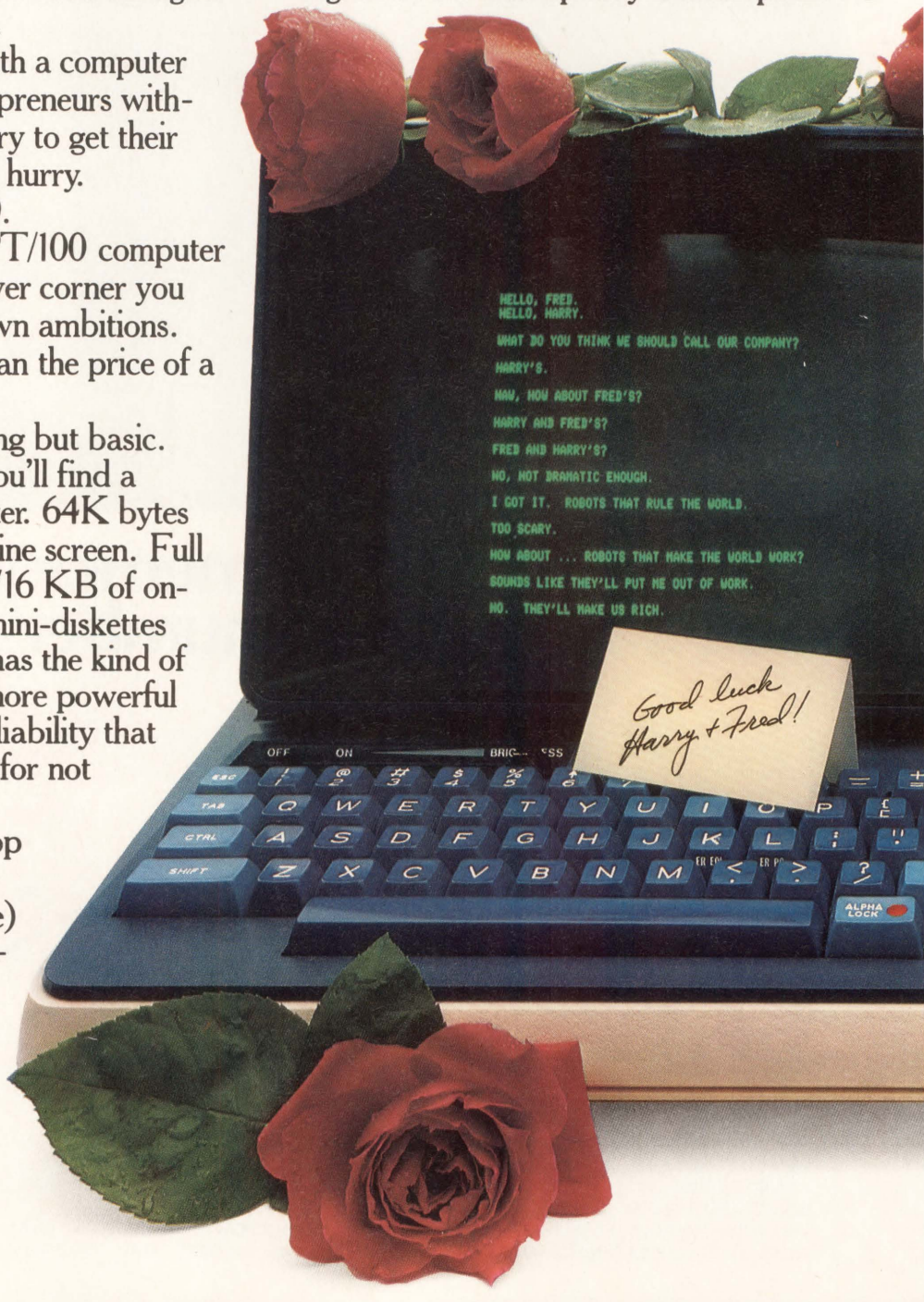
And it'll cost you less than the price of a basic new car.

This computer is anything but basic.

Inside the MPT/100, you'll find a 16-bit microNOVA™ computer. 64K bytes of memory. 80 column by 24 line screen. Full keyboard with numeric pad. 716 KB of on-line storage on two 358 KB mini-diskettes all packaged in a system that has the kind of software, compatibility with more powerful computers, ease-of-use and reliability that desk-top computers are noted for not having.

Also unlike most desk-top computer software, some very sophisticated (read easy-to-use) big computer software is available for the MPT/100 computer: A multi-tasking FORTRAN that meets all the ANSI standards.

A PASCAL that executes at assembly language speeds. An ANSI compatible BASIC that lets you write enormously complex programs that take up only a little space. A



full range of user-friendly interactive programming aids. And MP/OS, an operating system anyone who's into operating systems will tell you is one of the most advanced in the world.

(Anyone who considers any of the above to be of trivial importance should consider the fact that a single line of application code costs a good deal more than many microcomputers. And that cost is only going one way.)

Saving money on programming is only part of the attraction of the MPT/100. It also saves you time. So you can get your company up and running before anyone can do the same thing.

As you grow, all the software you've written, all the peripherals you've interfaced, all the blood, sweat and tears you've put into your company will grow with you. Because we've invested no small amount of energy working to make our computers compatible.

The point here is that the MPT/100 can make you what a lot of companies have become with Data General.

Like Aero Systems Engineering, of St. Paul, Minnesota, for example. They're far and above the leading manufacturer of computerized aircraft jet engine testing systems. A position they came to occupy partly by building test facilities that could cut fuel consumption rates by 35%. Partly because of our world-wide service. And partly because they didn't have to wait eighteen months to get our computers.

There is no stopping you from doing the same thing.

If you want to get more detailed information about the MPT/100 computer, call your local Data General office or your Data General manufacturer's representative. Or the distributors listed below. Or write us at: MS C-228, 4400 Computer Drive, Westboro, MA 01580.

MPT/100 computers are available for off the shelf delivery from:
SCHWEBER, HALL-MARK, KIERULFF, ALMAC/STROUM and R.A.E. in Canada.

Look at it this way. All of you who want to start your own computer company, are very lucky people. We didn't have anybody to write to when we got started.

Data General
We take care of our own.

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CIRCLE 60 ON INQUIRY CARD

MEMORY SYSTEMS

A duplicate copy of each data track is created on a disc drive other than the one where the primary copy is stored. These three capabilities allow the system to recover or reconstruct lost data in the event of a media or device failure. The recovery process is controlled by operating software, and is transparent to the user.

The system interface between host processor and VCP is an intelligent channel adapter that emulates a control unit and enables read/write transactions at channel speed. This speed is 1.5M bytes/s using standard channel protocol and 3M bytes/s when connected to streaming data channels.

Each channel adapter uses two Zilog Z8000 microprocessors that operate in parallel for system integrity. The Z8000s access data, block and unblock records, identify files, and interpret read/write commands from the host. A Signetics 8X300 handles channel interface management. Another basic element in the channel adapter, data transfer and data compression hardware, functions to offload host CPU time.

The VCP bus architecture allows channel adapters to access memory without CPU intervention. When a track buffer in VCP memory has been filled or emptied, the adapter queues an appropriate message to the VCP, which then reads or writes to backend disc or tape storage. A VCP with eight channel adapters can handle bursts in excess of 10M bytes/s between VCP and host processor. The VCP is an IBM-compatible Magnuson 370/148 mainframe.

Programs resident in the VCP to control storage management, backup/recovery, and system utilities require 130k lines of Pascal; another 15k lines of ACL code govern system utilities to form a modified DOS. Another 45k lines of Pascal and 54k lines of ACL are resident in the host operating system (MVS), enabling the user to specify VSS as the storage subsystem and to access data according to standard I/O access methods.

—James W. Hughes, Senior Editor

Circle 263 on Inquiry Card

RAM storage system serves medium to large IBM systems

Available in either 12M- or 24M-byte configurations, FAST-3815 intelligent memory system with random access memory (RAM) transfers data at maximum channel data rates of 1.5M to 2.0M bytes/s. It is an entry level version of the FAST-3805 semiconductor disc previously announced (*Computer Design,* July 1979, pp 40-46) by Intel Corp, Commercial Memory Systems Operation, 12675 Research Blvd, PO Box 9968, Austin, TX 78766. The system is described as offering faster (0.8-ms) access speed and "managed" storage for IBM 4300, 158, 168, and 303X users.

Intelligence is afforded the system by an iSBC-86/12™ single-board computer that manages all channel protocol and memory data interface between the RAM technology memory and the IBM host. The board and supporting electronics perform self-healing diagnostics, including double-bit error correction and multiple-bit detection. The system also records in its own memory the board and device location of any errors, automatically transfers data to spare storage, continuously performs a software sweep, and logs bad devices. The memory system is designed to accommodate either 16k- or 64k-RAMs; initial shipments will use 16k-RAM devices.

The system is designed for situations where IBM or look-alike systems have become I/O bound because of heavy use of MVS, TSO, VM/CMS, IMS, or high activity online applications where there is increasing contention for system resources. The company says that the new semiconductor disc, unencumbered by rotational and mechanical delays, may have a significant impact on favorable price/performance ratio when a user's average paging/swapping rate exceeds 35 pages/s. When paging requirements exceed 225 pages/s, a field upgrade can be made to the FAST-3805.

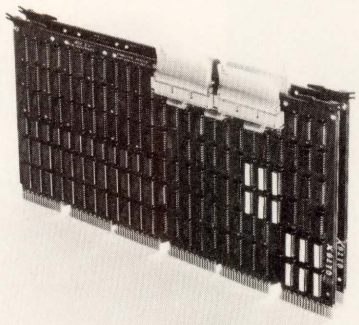
System options include native mode and two-channel switch. The former allows the user full advantage of each 12M-byte memory increment from its fixed-block architecture. There is no loss from interrecord gaps or other formatting inefficiencies associated with rotating discs. Two-channel switch option enables a single FAST-3815 to be shared between two channels. One memory system can be connected to one CPU, providing more efficient online processing, while concurrently increasing processing performance on another CPU.

A standard system measures 72″ x 60″ x 30″ (183 x 152 x 76 cm). Space, cooling, and power requirements are significantly less than for comparable rotating disc systems. Purchase price for a 1-controller 24M-byte system is $144,000; the 1-controller 12M-byte system is priced at $84,000. Leasing price schedules are available.

Circle 264 on Inquiry Card

Fast Image Filtering
In Seconds, Not Minutes

Our $4950 Array Processor cuts the time to run 2-dimensional digital filters from minutes to seconds. The MSP-3X's two hex boards plug right into your PDP*-11 minicomputer to boost your system's speed by a factor of 20 to 50.



MSP-3X array processor

Our MSP-3X's built-in library of subroutines gives you the spatial and frequency domain functions that you need to get the picture you want. Apply Fast Fourier Transforms and fast image convolutions to your data. Operate on your one and two dimensional arrays with any of the library subroutines simply by including a subroutine calling statement in your FORTRAN program.

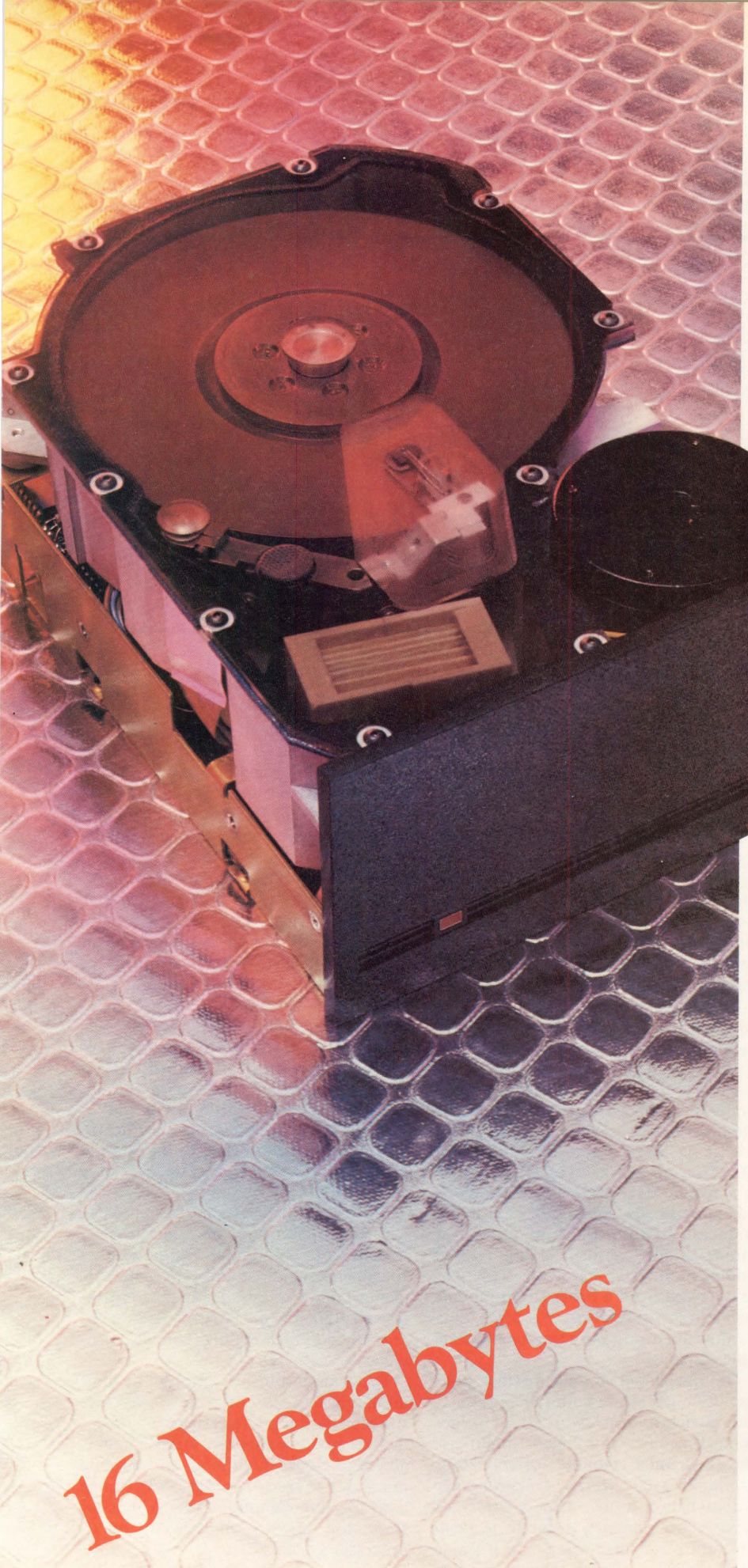
Simple and reliable operation, a package that fits into your system without hassle, and a price that fits into your budget just as easily make the MSP-3X a sensible choice for better digital image processing.

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To find out how you can have the superior Winchester drive in your system, call us at (213) 709-6445 today for complete specifications, prices and for immediate delivery of an evaluation unit.

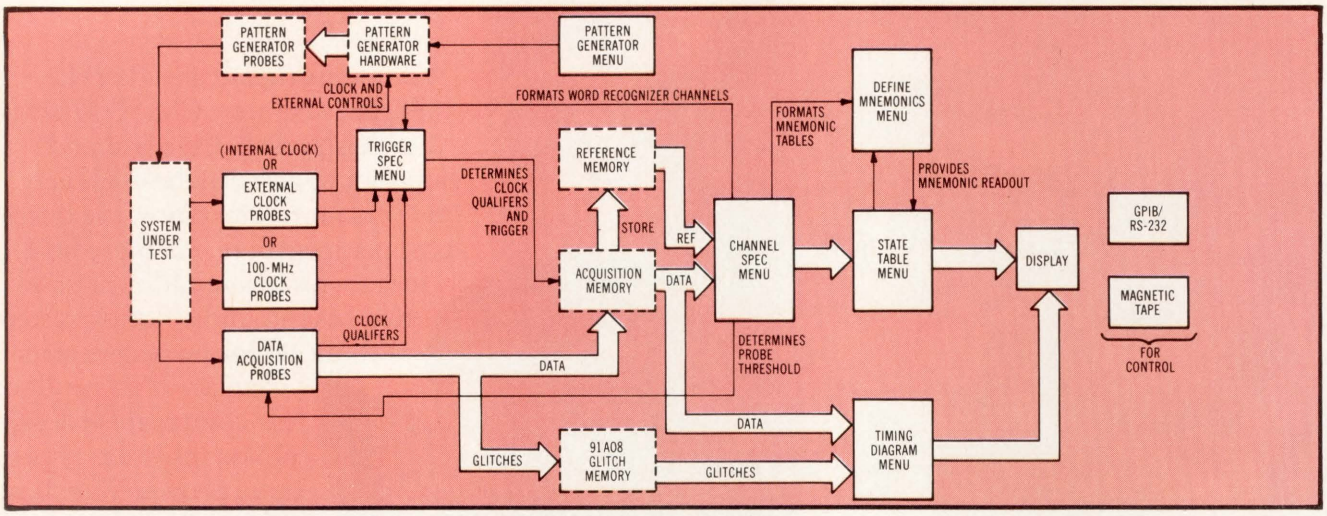
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(213) 709-6445 TWX 910 494-4834

CIRCLE 62 ON INQUIRY CARD

TEST & MEASUREMENT

Logic analyzer/pattern generator combination simulates/evaluates hardware/firmware responses



Modular architecture of Tektronix's DAS 9100 supplies 104 channels of data acquisition, synchronous and asynchronous sample rates to 330 MHz, resolution to 1.5 ns, and up to 80 channels of pattern generation

High performance logic analysis and pattern generation combined with mass storage and communication interfaces in the DAS 9100 digital analysis system makes system design easier. The modular package offers designers the opportunity to interactively simulate and evaluate responses of circuits or systems before hardware or firmware is complete. Another attribute of the system, developed by the newly formed Design Automation Div of Tektronix, Inc, PO Box 500, Beaverton, OR 97077, is that it eliminates the need to develop test fixtures or test code to evaluate prototypes.

Architecture of the modular system provides for up to 104 channels of data acquisition, synchronous and asynchronous sample rates to 330 MHz, resolution to 1.5 ns, and up to 80 channels of pattern generation at 25 MHz. Based on a microprocessor controlled mainframe with a 9″ (23-cm) raster scan CRT, the system is built by plugging modules, selected for specific data acquisition or pattern generation capabilities, into six available slots. Since each card contains all firmware specific to its function, system software is minimized and menus are simplified; they relate directly to those cards actually in the machine rather than having to deal with all possible conditions.

Operation is simplified by a color coded functional keyboard and color coded probe pods. A button on the pod, when depressed, displays the pod number and group on the CRT screen, eliminating the need to trace connections back to the board. Another bonus is that pods can be reassigned from the keyboard. Prompts from the display allow users to access instrument setup menus that highlight variable parameters.

Single keystrokes initiate data acquisition and pattern generator functions individually or in combinations, load reference memory, run tests comparing acquired data against reference memory, and display data in state table or timing diagram format. Scroll keys permit examination of the whole 512-word acquisition memory. Users are also permitted to reformat displayed data, magnify the timing diagram format, and edit data in reference memory.

The three available data acquisition modules can be intermixed in various combinations to provide up to 96 channels at 25 MHz, up to 32 channels at 100 MHz, up to 16 at 330 MHz, and up to 8 at 660 MHz (1.5-ns resolution). A maximum of 104 channels of data acquisition can be formed. A unique trigger arming mode permits a high speed module monitoring hardware activity to be triggered from a lower speed module tracking software flow. Acquired data are time aligned in both timing and state table displays.

The 32-channel module provides 40-ns resolution (25 MHz) both synchronously and asynchronously with 512 bits per channel memory and 2 clock qualifiers. The 8-channel module offers 10-ns resolution (100 MHz), synchronously and asynchronously, with 512 bits of memory per channel, separate acquisition and glitch memories, and a single clock qualifier. The 4-channel module supplies 3-ns resolution (330 MHz) both synchronously and asynchronously and has 2048 bits of memory per channel. A high resolution mode provides 1.5-ns resolution (660 MHz) on two channels.

Pattern generation modules support interactive design by stimulating memory or I/O ports, or simulating microcode and hardware. A single module provides 16 channels of pattern generation at 25 MHz with two independent programmable strobes. Adding one or two 32-channel expander modules extends this to 48 or 80 channels with up to 10 programmable strobes.

Included in the pattern generator's instruction set are facilities for compression of output data and, with subroutines and loops, continuous output of patterns using a limited memory depth. Timing can be controlled by an external clock or by internal program selectable time base.

State table data can be formatted in hex, octal, binary, or user defined mnemonics. The timing diagram allows for label assignment and programmable channel designations. Timing magnification to 10,000X, memory window, word search, and glitch highlight are also provided.

Programmable thresholds accommodating TTL, MOS, or ECL are selectable for each card module. Triggering modes include word recognizer, event counter, glitches, clock qualifiers, and arming mode. Up to three external clocks can be used to allow demultiplexing of bus information and/or analysis of multiprocessor systems.

(continued on page 108)

How to package your computer without boxing yourself in.

UNITED TECHNOLOGIES MOSTEK



Matrix 100. The STD BUS User-Configurable Computer for OEM's.

Matrix 100 is unlike any other computer available. It's user-configurable. Which means, quite simply, that you can quickly and easily customize it. Precisely. And cost-effectively.

Instead of a fixed hardware configuration, for example, you determine the amount and type of memory, I/O and/or special functions you need. Final assembly is literally a snap because Matrix 100 accepts industry-proven Mostek STD BUS boards as the hardware system components.

There are 36 boards in all, and each one is already assembled. Tested. Debugged. And modularized so that you only have to buy those functions you need.

To create virtually any hardware combination, just make your selection and plug up to 10 STD BUS boards into the Matrix 100. Within minutes, you'll be ready to start the application software.

Included within the industrial quality, rack-mountable chassis are an eight-inch 512KB floppy disk drive and a complete power supply. A CP/M* compatible operating system is also available that will enable you to work with an extremely large number of pre-written programs.

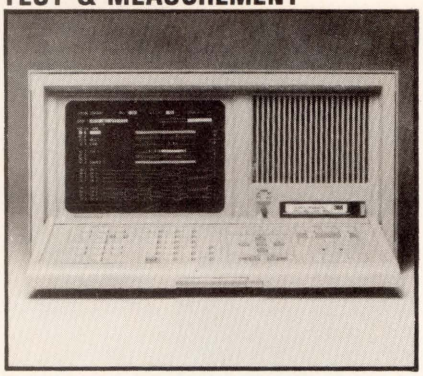
As for the future, Matrix 100 is just the first member of a complete user-configurable computer family. A family that will include a dual floppy disk drive version plus another with a 5¼ inch hard disk Winchester as well.

If all of this sounds enticing, the price will make it even more so. Because by buying only and exactly what you need, you can make the system components learning curve work for you. Without cutting corners. Find out how. Write Mostek Corporation, 1215 West Crosby Road, MS 509, Carrollton, Texas 75006 (214) 323-1829. In Europe, contact Mostek International at (32) 2.762.18.80. In the Far East, Mostek Japan KK (03)-404-7261.

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CIRCLE 63 ON INQUIRY CARD



The optional DC-100 magnetic tape drive allows users to both load and store system setup information, pattern generator programs and tests, reference memory data, mnemonic tables, etc. Tape can provide for transfer of test and evaluation routines to production test personnel and service organizations.

An RS-232-C port, GPIB interface, and standard video out are supplied in the optional communications package. The RS-232-C port and GPIB interface allow remote control/programmability of the instrument and transmission of acquired data to another 9100, computer, or GPIB controller. Two systems can be operated remotely in a master/slave configuration. In GPIB mode, the system can perform as a listener, programming all keyboard functions and downloading programs and data; or as a talker, transmitting test setups and data or performing service requests. Video out enables users to obtain hardcopy of the CRT display.

Four system configurations are offered. The DAS 9101, priced at $11,700, is a medium speed logic analyzer with 16 channels of data acquisition at 100 MHz and glitch trigger for small system hardware debugging. The 9102, at $12,900, focuses on the software integration task in small systems. It provides 32 channels of acquisition at 25 MHz with flexible triggering and 16 channels of pattern generation. Priced at $16,900, the 9103 is oriented to hardware debugging of large logic systems and random logic sections of smaller systems. It integrates 32 channels of acquisition at 25 MHz, 8 channels at 100 MHz, and 16 channels of pattern generation. Configured for hardware/software integration in large systems, the 9104, at $26,900, features 80 channels of acquisition—64 channels at 25 MHz for triggering from wide bus structures, and 16 channels at 100 MHz for resolving high speed control signals. 16 channels of pattern generation provide limited system stimulus, and magnetic tape permits mass storage and retrieval of data and instrument setups.

—Peg Killmon, Senior Editor

Circle 265 on Inquiry Card

Magnetic tape exerciser reduced to pocket size

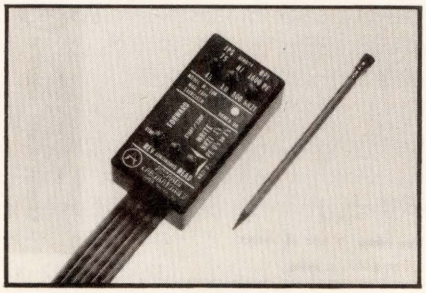
Specifically designed for field service applications, model M-200 microminiature mag tape exerciser is a compact unit for offline checking, adjusting, and troubleshooting of Wangco, Pertec, and other mag tape transports having a standard interface. The device, developed by Accardi Laboratories, 66-45 69th St, Middle Village, NY 11379, measures 5″ x 2.625″ x 1.625″ (12.7 x 6.7 x 4.1 cm) and weighs 12 oz (336 g).

It is compatible with 7- and 9-track transports, vacuum chamber and tension arm drives, 800-bit/in (315/cm) NRZI and 1600-bit/in (630/cm) phase encoded data formats. It will handle any two transport speeds; 45″ and 75″ (114- and 191-cm)/s speeds are standard.

The device is an open loop exerciser intended to provide maximum control over tape drive operation and to simplify servicing. Open loop signifies that the read outputs of the drive are not fed back to, or monitored, by the exerciser. Read checking is done by observing the drive read outputs on an oscilloscope to ensure that no tracks are picking up or dropping bits, and at the same time to verify that skew characteristics are within tolerance. Examination of a drive with the M-200 provides quantitative as well as qualitative information about pertinent drive characteristics such as gains, thresholds, skew, and start/stop.

Seven multifunction switches provide all of the read, write, and motion combinations necessary to exercise a transport. Continuous, or start/stop motion in either forward or reverse direction, is selectable. Any data on a tape can be read, or 1s or 0s in either NRZI or phase encoded formats can be written. A threshold level select switch, mounted on one of the interface connector transition boards, is configured as a momentary device so that normal thresholds are selected. However, the switch may be manually held in one of the two alternate threshold positions.

Power requirement of 5 V at 200 mA is automatically derived from the drive



being exercised through the control interface connector. Alternatively, power can be obtained via a jumper to the drive's 5-V logic supply.

Single-unit price of the exerciser is $495; quantity price is $295 in 100-quantity lots. Small quantity orders are available from stock, otherwise delivery is typically 30 days ARO.

Circle 266 on Inquiry Card

Converter allows any multimeter to measure fiber optic system parameters



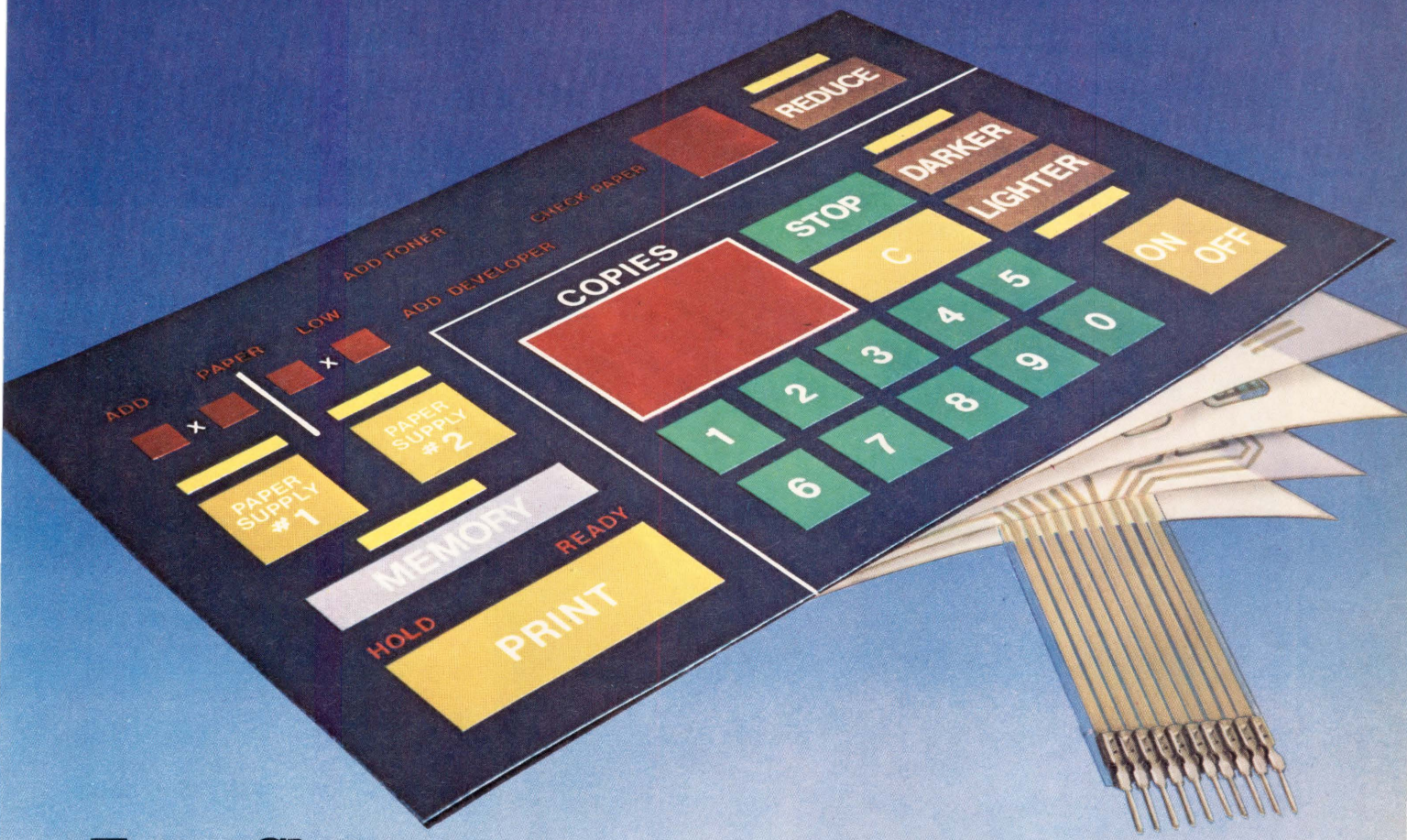
Fiber optic converter FOTEC C converts standard multimeters into fiber optic power meters. It can be used with any multimeter or voltmeter to measure such fiber optic system parameters as fiber attenuation, connector or splice loss, power coupled into fibers from a source, or signal level at the receiver. The converter was designed to serve laboratory measurement applications and is also suitable for field service of fiber optic installations according to FOTEC, Inc, PO Box 246, Boston, MA 02129.

The device measures signals in an optical power range from less than 20 nW to over 2 mW with ±5% accuracy in any signal frequency from dc to hundreds of megahertz. It handles sources in the 400- to 1100-nm range and can be easily recalibrated for various source wavelengths. The linear dc signal output is calibrated on two switchable ranges as 1V/μW or 1 V/mW. When used with a 3.5-digit DMM, the converter gives 1-μW resolution on the mW range and 1-nW resolution on the μW range. Integral auto-zero circuits maintain high accuracy over a broad range of operating conditions.

Completely portable, the unit measures 1.5″ x 3″ x 5.25″ (38 x 76 x 133-mm) and weighs 7.5 oz (212 g). It is powered by a single 9-V battery with up to 250-h lifetime. Various models provide compatibility with most fiber optic connector systems. Single unit price is $250, with 2- to 4-week delivery. Quantity discounts are available.

Circle 267 on Inquiry Card

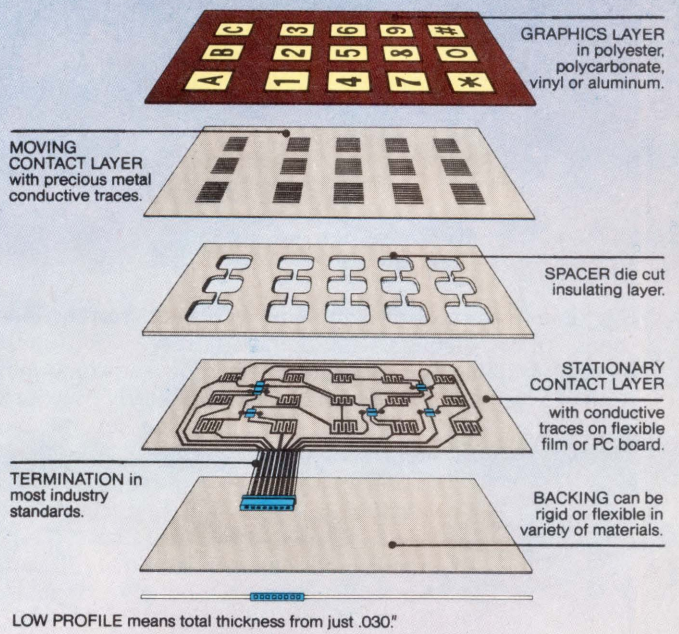
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CIRCLE 64 ON INQUIRY CARD

DATA COMMUNICATIONS

X.21, X.25 data transmission options are available for IBM systems

A computer program product, hardware device, and features to enable IBM systems network architecture (SNA) products to communicate using services based on the X.21 or X.25 international standards have been announced by IBM Corp, Data Processing Div, 1133 Westchester Ave, White Plains, NY 10604. The products enable IBM systems users to access public packet-switched, circuit-switched, and leased-circuit services of public data networks, as well as the conventional services of the SNA networks.

Recommendations X.21 and X.25 are standards adopted by the Consultative Committee on International Telegraph and Telephone (CCITT) to define interfaces between processors or terminals and public data networks. X.21 defines the interface to public data networks that offer leased-circuit and circuit-switched services, and is also the physical, first-level interface preferred by the CCITT for X.25 packet-switched services.

Recommendation X.25 defines three levels of protocols and rules governing packet-switched services. In these networks, data are transmitted in discrete groups or "packets" allowing common communication lines to be shared by different users.

Since 1974 SNA has continued to be IBM's design framework for programs and devices that handle data transmission within networks, and provides such higher level functions as routing and flow control, network management, and data presentation.* The current announcements reaffirm the company's May, 1980 Statement of Direction that encouraged the use of international standards as the basis for interfacing to public data networks.

X.25 Network Control Program (NCP) is a packet-switching interface program product that operates in selected models of the IBM 3705 communications controller. It enables users to transmit and receive data through X.25-based packet-switched data networks. In conjunction with IBM's network control programming, the product provides transmission control, data formatting, error recording, testing, and other higher level functions. Such functions enable the 3705 controllers to communicate via packet-switched network services with a variety of SNA terminals and distributed processors. NCP also allows data transmission over packet-switched facilities to non-SNA terminals that are equipped to handle X.25 protocol.

The Network Interface Adapter (NIA) is a hardware product that converts SNA's synchronous data link control (SDLC) protocols to and from X.25 protocols. NIA allows certain SNA terminals and IBM processors that do not use 3705 controllers to communicate over an X.25-based network.

Included in the announcement were features that will permit various SNA devices to communicate over X.21-based services. X.21 nonswitched features will be available on selected models of the 3705 communications controller, and on certain SNA models of IBM terminals and processors. Currently these features are supported by IBM Advanced Communications Function (ACF) programming.

X.21 switched interface features will be available on selected models of the 3705 controller, and on certain SNA models of the 3274 display station and 8100 information system. Circle 268 on Inquiry Card

*Howard Frank, "Updating the SNA/Packet Switching Debate," *Computer Design*, May 1980, pp 12-24



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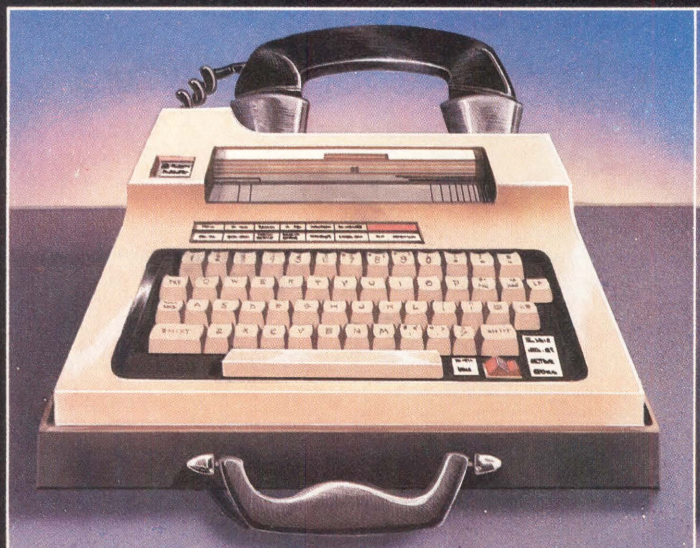


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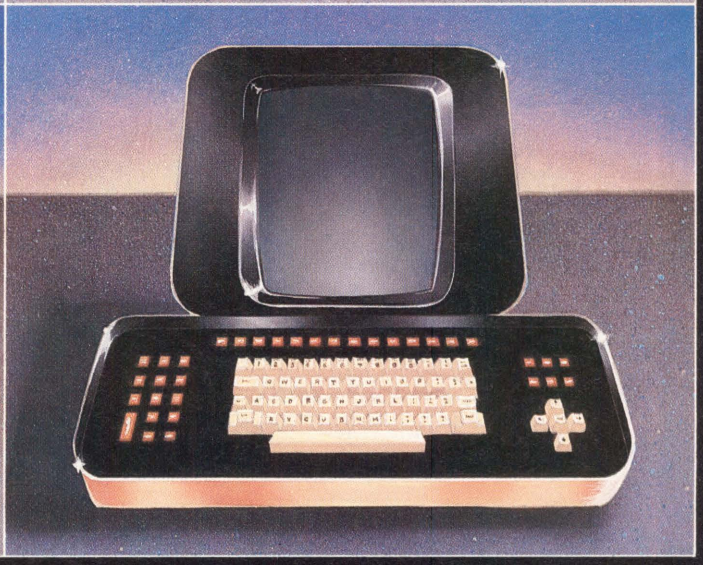
CIRCLE 65 ON INQUIRY CARD

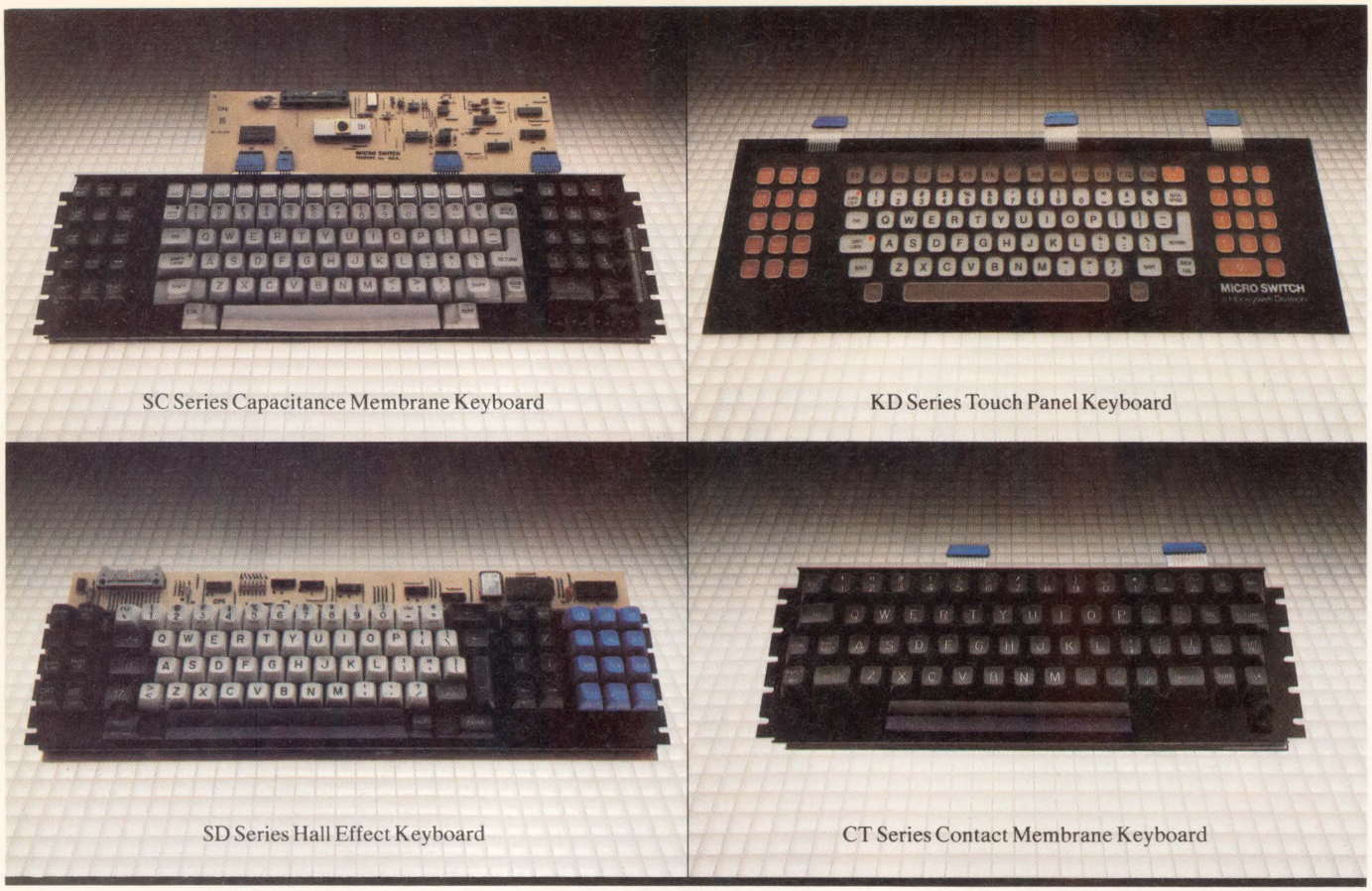
Wouldn't it be great if every kind of keyboard had our kind of performance?











SC Series Capacitance Membrane Keyboard

KD Series Touch Panel Keyboard

SD Series Hall Effect Keyboard

CT Series Contact Membrane Keyboard

Now they do.

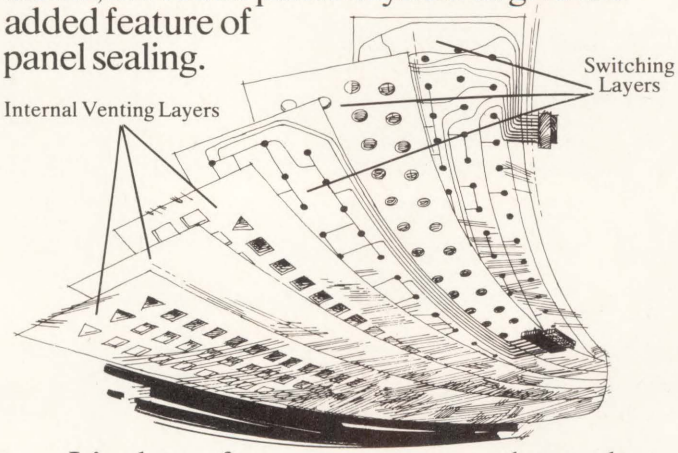
Until now, getting a keyboard at the price you needed could have meant giving up the kind of performance you wanted.

But not anymore.

Because, with the introduction of three new membrane keyboards, MICRO SWITCH has become the world's only full-line supplier of reliable keyboards. We offer a high-performance and cost-effective solution for virtually any application.

Now, in addition to our time-proven Hall effect offerings, you can specify MICRO SWITCH SC Series full-travel capacitance membrane or CT Series contact membrane keyboards, and KD Series touch panel membrane keyboards.

Whatever type of seal you need, all you have to do is ask. The capacitance membrane units are the world's only capacitance keyboards with all the benefits of membrane sealing. And we're the first to solve the venting problems associated with previous membrane designs. Both our capacitance membranes and contact membranes are internally vented to maintain their seal while preventing switch collapse due to air pressure or temperature changes. And for especially severe environments, the touch panel keyboards give the added feature of panel sealing.



It's those features, among others, that make these new keyboards more reliable than other capacitance and hard-contact designs.

And because all three new keyboards have been designed with traditional MICRO SWITCH quality and reliability, each carries a 1% Acceptable Quality Level and 2-year warranty.

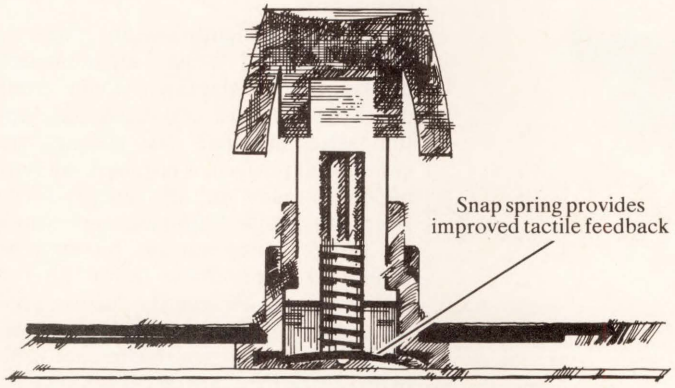
Now any combination of keyboard features you can name can have the MICRO SWITCH name on it.

Now your keyboard specifications are only limited by what you want. Not by what you can get.

Our full-travel series, for example, are available in a wide variety of keyboard configurations, with a choice of over 40,000 legends.

Because legends are screened on our touch panel designs, the graphic possibilities are endless. And, we can combine full-travel and touch panel actuation in a single assembly, featuring either capacitive or hard contact technology.

We make it easier to comply with European standards, because our full-travel membrane designs are available in low-profile versions to meet world requirements.



And, the actuator module for the full-travel membrane keyboards helps achieve new levels of tactile feedback and operator satisfaction.

So you can come to MICRO SWITCH for the keyboard technology, travel, actuation, sealing, appearance, profile, electronics, and special features you need.

And get them all – backed with the experience and full application support that's been a MICRO SWITCH tradition.

Being able to design a keyboard to fit any application is important. But doing it to fit any operator is imperative.

It's important to understand that half of any keyboard application is a human being. There's probably no keyboard manufacturer who understands that better than MICRO SWITCH.

Our unique human factors research – an intensive, on-going program for over 20 years – has given us the tools to develop industry standards for key speeds and multi-key rollover; tactile, visual, and audible feedback; and various keytop shapes, spacing, configurations and travel. We're continually improving the man/machine interface.

This human factors research is part of



what makes our keyboards unique. And it's part of every keyboard we make.

Instead of resting on our laurels, we're relying on our research.

Being able to add state-of-the-art capacitance membrane, contact membrane, and touch panel keyboard types to our Hall effect offerings is the result of extensive planning, research and testing.

But it's only the beginning.

Each of these keyboard types will be continually subjected to the refinements growing from our human factors research, customer feedback, and our unmatched R&D facilities which include backup by our Honeywell corporate facilities.

Also, every keyboard customer benefits from a manufacturing capability that stands unmatched: it's large enough to handle the most extensive order; responsive enough to give the modest order the same kind of intensive, individualized and quality-conscious attention.

All of these efforts are to make sure that, as your keyboard needs change and grow, you'll always have the choice of a progressive alternative with one unchanging feature: the MICRO SWITCH name. With all the performance that name implies.

For more information on our keyboard technologies, call 815-235-6600. Or write, MICRO SWITCH, the Keyboard Consultants, Freeport, IL 61032.

MICRO SWITCH
a Honeywell Division

CIRCLE 66 ON INQUIRY CARD

DATA COMMUNICATIONS

Terminal concentrator features simple programming, multiplexes up to sixteen terminal devices over single link

Terminal concentrator TC-5 is a general purpose statistical multiplexer that allows 4, 8, 12, or 16 asynchronous terminal devices in one location to communicate with a computer located elsewhere over a single leased, dial-up, or directly wired metallic line. Terminal data rates range from 50 to 9600 bits/s, and the concentrated link can be synchronous or asynchronous with data rates from 1200 to 9600 bits/s. The concentrators, from ComDesign, Inc, 340 S Kellogg Ave, Goleta, CA 93117, are paired in a master/slave configuration to form a flexible communications system.

Each system port can be programmed to any one of 10^{10} different configurations without interrupting service to the unchanged ports. Each port can be configured at 15 terminal port data rates from 50 to 9600 bits/s in 45 different data formats, from 5 to 8 bits with even, odd, or no parity, and 1, 1.5, or 2 stop bits. There are 49 different selections for the line's flow control, comprising seven different flow control choices at one end of the system, combined with an independent choice at the other.

Data rate of the concentrated line can be configured at 1200, 1800, 2400, 3600, 4800, 7200, or 9600 bits/s. This line can be either a direct metallic, dial-up, or leased line using modems. The system can be programmed to use its own internal clock with direct-connect or with asynchronous modems, or the modem's clock can be used for a synchronous connection.

Different configurations are programmed using the 8-char alphanumeric display (for prompting), three front panel pushbuttons, and a one-page option selection guide. No internal DIP switch manipulation is required. All port parameters can be set independently from either unit. Parameters are stored in power-independent permanent memory for automatic restart after a power failure. A security feature protects against unauthorized programming. Standard system buffer size is 8k bytes; a 32k-byte memory is optional.

A set of status monitoring functions provides information on system, port, and concentrated line status. Status information is displayed on front panel indicator lights and on the alphanumeric display.

The concentrated line protocol conforms to ADCCP ANSI X3.66, similar to X.25 Level 2 and HDLC. It uses a cyclic redundancy check (CRC) with go-back-N ARQ for error correction. Rate of undetected errors in a data block is said to be better than 1 in 10^{12}.

Several useful options are available to the system, including autobaud, dial-up handshake, different master/slave speeds, echoplex, terminal activated loopback and pattern tests, and lost-data/link-down alarms.

Each unit measures 2.5″ x 12.5″ x 13″ (6.4 x 31.8 x 33 cm) and weighs 12 lb (5.4 kg). Power requirement is 110 Vac, 50-60 Hz, 0.25 A, or 220 Vac, 50-60 Hz, 0.125 A.

Single quantity prices for the concentrator are: 4-line unit, $1625; 8-line, $2450; 12-line, $3300; and 16-line, $4150. OEM quantity discounts are available.

Circle 269 on Inquiry Card

For demanding applications



SUMMAGRID™

The full-sized digitizer with uncompromising accuracy

Designed to meet the rigid requirements of aerial cartography, integrated circuit layout, printed circuit board design, architectural drawing and other uses where dependable accuracy and resolution are required, Summagrid delivers *provable* —

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ACCURACY: ±0.005″ (0.125mm)

Despite variations in temperature and humidity.

Available in opaque or backlighted models with active areas as large as 42 by 60 inches. A product of the world's largest digitizer manufacturer.

Designed for easy integration into almost any data processing system, it offers RS232, IEEE and 8/16-Bit Parallel interfacing. A wide range of accessories and programming features are available.

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CIRCLE 67 ON INQUIRY CARD

DIGI-DATA VALUE MEANS:

A DEI Funnel* Replacement That Is More Reliable And Costs Less

Just plug our cartridge tape drive in. It is DEI Funnel compatible in size, medium and interface.

But it's not equal.

The Digi-Data Model 6400 cartridge tape drive has superior reliability. Its direct capstan drive and optical tachometer assure constant tape speed. Cable termination control maximizes noise immunity. The 6400's computer optimized servo design with fewer adjustments means attention-free operation.

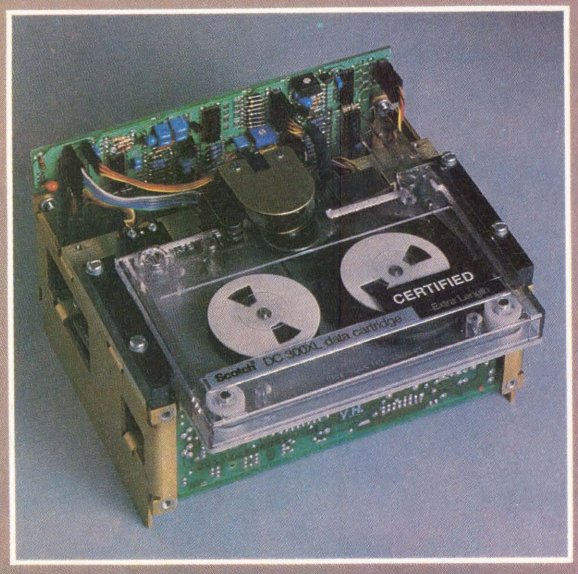
Digi-Data's Model 6400 cartridge drive gives you more than 17 Mbytes of data storage for disk backup or archival storage applications. And, it costs only $1390 in single unit quantity.

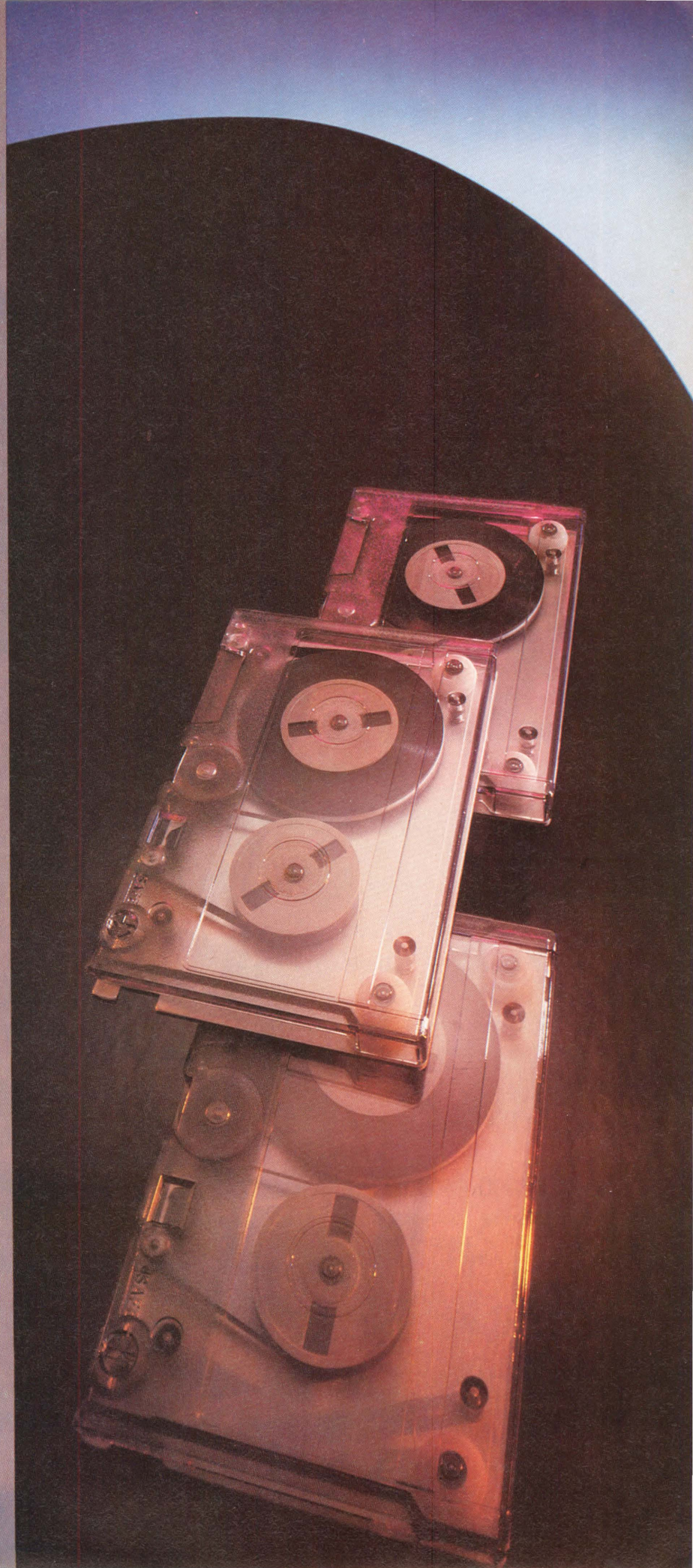
Digi-Data was first known for reel-to-reel tape transports. Then we added dot matrix printers and now cartridge recorders...still with the best OEM prices in the industry.

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CIRCLE 68 ON INQUIRY CARD

DATA COMMUNICATIONS

Dial-up diagnostics pinpoint faults in remote data networks

Demonstrations of the capability to diagnose failures in remote data communications networks were recently conducted in New York, NY, and Boston, Mass, by Timeplex, Inc, One Communications Plaza, Rochelle Park, NJ 07662. The remote diagnostic capability is enabled through the supervisory port of the company's SERIES II MICROPLEXERS/data concentrators (*Computer Design*, Sept 1980, p 46).

During the online demonstrations, a company field service engineer used an ASCII asynchronous terminal, a 103-type modem, and the dial-up facilities to diagnose problem locations in Chicago's University of Illinois Library Computer System. This system is comprised of an IBM System/370 model 168 computer, 300 terminals, 100 printers, over 100 modems, and 60 SERIES II MICROPLEXERS. Two channels in the computer center had been deliberately "brought down" for purposes of the demonstration.

Network access was through the multiplexer's supervisory port. This independent data channel functions as a "window" into the system and adds high level control, monitoring, and diagnostics capabilities to the network. The faulty channels were quickly isolated and University personnel brought them back online. The problem was pinpointed and resolved with no interference to any other channel in the system.

Dial-up diagnostics capability monitors such functions as loss of data; marginal, intermittent, or hard failure in MICROPLEXER equipment; message transaction; line quality; and channel status. Dial-up diagnostics are generally completed through the company's field service headquarters in Hackensack, NJ. However, as the demonstration indicated, a trained technician can perform the diagnostics from any location via a portable terminal. Dial-up diagnostics are integral to the company's standard service contract.

—James W. Hughes, Senior Editor

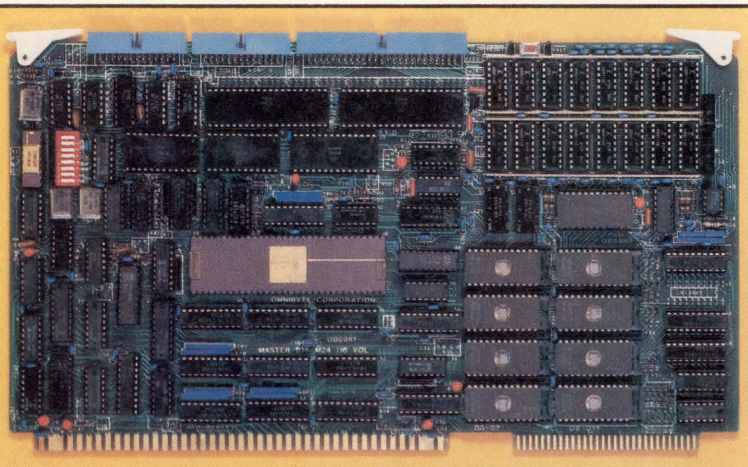
Circle 270 on Inquiry Card

CCITT compatible V.22 modem incorporates automatic adaptive equalizer

Designed for 1200-bit/s full-duplex operation on 2-wire dial-up telephone lines, CDS V.22 modem operates with both synchronous and asynchronous terminals, features fallback to 600-bits/s full-duplex, and alternately functions on 2-wire leased lines via an additional provided interface. The modem has been introduced by Concord Data Systems, Inc, 442 Marrett Rd, Lexington, MA 02173, and is said to be the first CCITT-compatible V.22 modem to use automatic adaptive equalization.

Data format is bit-synchronous or 8-, 9-, 10-, or 11-bit asynchronous. An optional alternative "C" allows 0 to 300-bit/s data transmission. The modem uses differential phase shift keying (DPSK) and has CCITT V.24/V.28 and RS-232-C as digital interface. The equalizer automatically and adaptively adjusts the unit's receiver to compensate for distortion introduced by the line and provides high error rate performance even with marginal line conditions.

(continued on page 120)



OMNIBYTE OB68K1®

MC68000 CPU on the MULTIBUS®/IEEE P796 BUS

1 OMNIBYTE CORPORATION has *in production* a single board computer that combines the powerful MC68000 16-BIT CPU with the popular MULTIBUS/IEEE P796 BUS. The OB68K1 will function in either a single or a multi-processor environment. All onboard memory is protected from access by other processors, permitting multiple boards to run concurrently. Since the OB68K1 will address up to 16 megabytes of memory, it is possible for several boards to access a common pool of memory and I/O devices within a shared bus structure.

2 Because the board is configured with the same I/O arrangement as Motorola's MEX68KDM design module, software developed for the KDM module, including the MACSBUG® monitor/debugger, will operate on the OB68K1. An off-the-shelf operating system is available from Hemenway Corporation (Boston, MA), and high level languages will be available from several major software houses later this year.

FEATURES

- ★ the powerful MC68000 16-BIT CPU
- ★ MULTIBUS/IEEE P796 compatible
- ★ 32K or 128K bytes of RAM
- ★ up to 64K bytes of EPROM
- ★ 8MHz processor speed
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- ★ (2) RS232C serial ports
- ★ (2) 16-BIT parallel ports
- ★ a crystal controlled baud rate generator with 16 standard rates
- ★ a triple 16-bit timer/counter
- ★ user programmable memory mapping PROMs

FOR MORE INFORMATION ABOUT THE OB68K1, ASK FOR OUR FREE SUMMARY SHEET OR SEND $10 FOR A DETAILED TECHNICAL MANUAL.

CONTACT: RANDY COCHRAN,
Marketing Manager

OMNIBYTE

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CIRCLE 69 ON INQUIRY CARD

DIGI-DATA VALUE MEANS:

High Speed Tape Drives That Use The Most Proven Design In The Business

Digi-Data helped pioneer development of tension arm digital tape recorders in the late 60's. Since that time more than 200,000 units using that simple, reliable mechanism have been shipped by Digi-Data and its competitors.

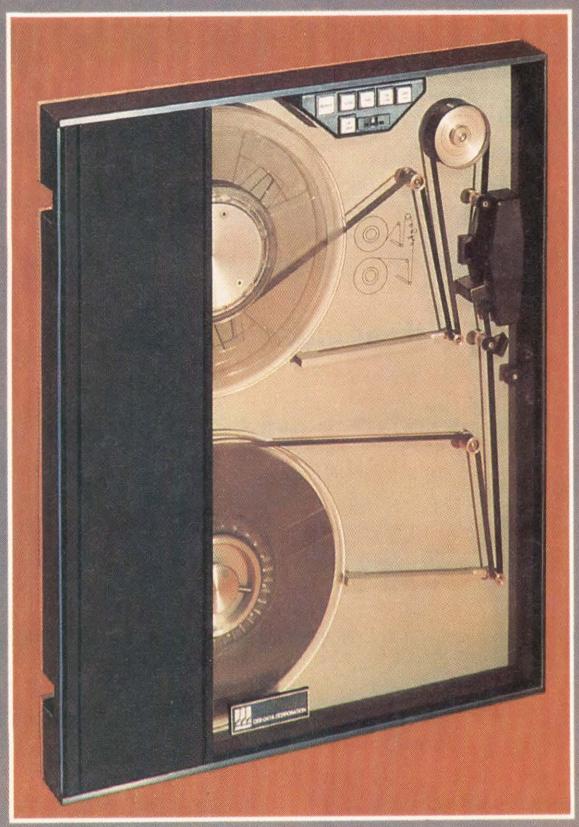
Now Digi-Data has field proven the tension arm design at 75 ips.

Forget the noise, power consumption and complexity of 75 ips vacuum column machines and enjoy the substantially lower cost of Digi-Data's model 1849 drives.

In addition to our complete line of ½ inch drives, we also manufacture computer compatible interfaces, cartridge tape drives, and dot matrix printers . . . all with the best OEM discounts in the industry.

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CIRCLE 70 ON INQUIRY CARD



Intel's Series 90/iQX. The memory

Intel's new Series 90/iQX is the first standard Intelligent Memory System to offer continuous operation and high maintainability at low cost.

Now, for the first time, OEMs can design systems with built-in protection against errors, downtime, and excessive maintenance costs. How? With Intel's new Series 90/iQX.



Series 90/iQX Intelligent Memory System

The iQX controller adds the intelligence of an iAPX 86 microcomputer to the standard Series 90 Memory System. Intelligence that monitors memory operation directly, detects and corrects errors, runs local or remote diagnostics, and reallocates memory space as required. All without burdening the host system.

Fault-tolerant operation

Hard errors or soft, Series 90's iQX controller uncovers them. Soft errors are simply "scrubbed" and corrected. In case of hard errors or device failure, the controller routes data around the problem, allocating spare memory as needed. It then logs the error for future reference.

With protection like this, the Series 90 system will continue operating uninterrupted until all spare memory is filled.

And thanks to the iQX's memory status reporting, your customer will know well in advance of memory resource problems. Which not only improves data integrity, but increases reliability and reduces maintenance dramatically.

Instant diagnostics

To keep users continually apprised of conditions within their memory system, the iQX controller provides easy access to its complete diagnostic file. Information can be accessed by the host system either automatically via a simple message-driven software interface, or manually, using the iQX's Service Communicator. This detachable terminal allows technicians to instantly retrieve diagnostic data in plain English through a compact, alphanumeric keyboard/display. With no interruption of the host computer's operation.

For fast, simple maintenance, system diagnostics inform the user of any



machine with non-stop intelligence.

errors it has tracked—soft or hard, correctable or avoidable—and their precise location by row and column.

Many problems can also be solved using the iQX's memory tasking capability to move data blocks as required. Then too, the iQX monitors the system's power supply and signals a warning if voltages drop critically. As a final, double protection, the iQX controller even diagnoses its own operation continuously.

Diagnosing from a distance

To reduce maintenance costs for remote systems and networks, iQX diagnostics can be accessed over phone lines through a single diagnostic station. By being able to analyze problems from afar, you'll eliminate unnecessary service visits and shorten those that are required. And since one diagnostic station can easily serve up to 150 installations, the set-up and ongoing diagnostic costs are contained as well.

Consider the economics

The iQX's protection features offer important economic advantages for systems OEMs. Because of the increased demand for fault tolerance in today's marketplace, systems equipped with iQX capability add significant value to your products. In fact, many applications simply could not be justified economically *without* such self-healing and remote maintenance. Now, through Intel's leadership in 16-bit microprocessing, the Series 90/iQX brings you this capability at an incremental price only nominally above that of ECC alone.

In sum, iQX gives your systems state-of-the art fault protection, reduced maintenance costs, and therefore increased value. Best of all, Intel is delivering Series 90 systems with iQX right now. For detailed information, return the coupon to Intel Corporation, 3065 Bowers Avenue, Santa Clara, CA 95051. Telephone (408) 987-8080. For hot line service, call (800) 538-1876.

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CIRCLE 71 ON INQUIRY CARD

DATA COMMUNICATIONS

Signal processing and control are performed by high speed, low power microprocessors to reduce component count and power consumption. The modem operates in originate, manual answer, or automatic answer modes. Integral test and diagnostic capabilities include digital and analog self-test, with an internal test pattern generator and checker provided. Modem status and test results are displayed on LED indicators. All operating modes and diagnostic tests of the unit are activated by touch-sensitive front panel switches.

Power consumption is less than 10 W at 198-250 or 100-130 Vac, 48-65 Hz. The unit measures 9.25″ x 8.5″ x 2.7″ (23.5 x 21.6 x 6.9-cm), weighs less than 7 lb (3 kg), and is furnished in standalone or rackmount versions. Single-unit price is $965; volume discounts are available. Delivery is 60 days ARO.

Circle 271 on Inquiry Card

PERIPHERALS

Cartridge module adds versatility to dot matrix printing techniques

Cartridge module technique reduces the size and weight of typical printheads yet provides maximum print definition at high speeds. The thin cartridges, developed by Baudex Corp, 49 Richmondville Ave, Westport, CT 06880, achieve an eight times reduction in width compared to conventional serial printheads, and weigh less than 100 g. The technique stems from the invention of an electromagnet by Arthur Matschke, founder and president of Baudex, who holds several patents in printhead technology. The adjustable M-cell electromagnetics have a flat slender profile that allows their use in various head sizes and shapes.

Mounting singly or in multiples, the modules position horizontally to accommodate rack and panel installations where height is limited, or vertically to achieve multiline or multicolor printing. Mounted horizontally, the modules are as thin as ribbon cartridges and can be encased within them to save space.

Designed for maximum print definition using mylar or other nonfabric ribbons, the modules have a print stroke of approximately 0.020″ (0.051 cm) and a usable dynamic range that is proportionately larger than that of most printheads—the head will print with less than 0.002″ (0.005-cm) clearance from the wire end (after the ribbon). Rated frequency of the cartridge design is reduced to compensate for the long print wires used. This reduction increases the dynamic range or print surface displacement allowed while the printhead remains stationary at a fixed distance from that surface. The ability to print at higher speeds on thinner multistrike ribbon (0.001 to 0.003″ or 0.002 to 0.008 cm), combined with the precision afforded by the long parallel runs of the print wires, provides excellent dot overlay precision, and subtle color changes using otherwise conventional techniques.

Life of the cartridges is expected to exceed 1G characters because of individually adjustable print wires. If a wire wears, it can be adjusted in the cartridge, bringing it back into position reference with the other wires.

Multiple cartridges accomplish the same effect as dot overlay printing, a technique that uses multiple passes of the printhead over the paper to produce characters that approach typewriter quality. By using a cartridge head made up of several modules, high quality matrix printing can be achieved with single pass techniques. Mounted in descending array, the modules print overlapping dots in a single pass. Improvement in quality is achieved by simple electronic techniques at speeds several times higher than those attained using typewriter-like machines.

Printing multiple lines, two cartridges can provide 400-char/s speeds, as each cartridge is rated at 200 char/s. Printing multiple lines simultaneously is actually more efficient than running serial carriages at higher speeds and keeps noise levels down. Throughput is augmented by increasing the amount of memory in the machine; multirow printing of 600 or 800 chars/s can be achieved on a routine basis using this technique, according to Mr Matschke.

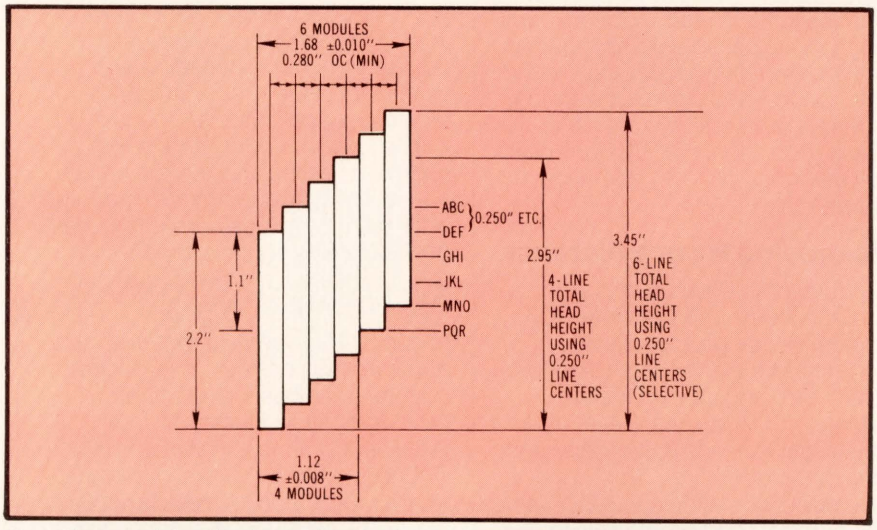
The main advantage of the horizontal mount model H is its compactness in a vertical direction, making it ideal for rack and panel installation where minimum printer height is accommodated, and in applications where minimum vertical height permits closer placement of other equipment. Typical examples are cash registers and some ticket printers. The vertical mount module offers combinations of vertically displaced print lines, including overlap, OCR, and graphic displacement; multiline printing; and multicolor printing. Multicolor printing is accomplished with a simple 3-color ribbon operating in parallel mode.

All engineering models are made with the print wire row (vertical axis) parallel to the cartridge plane for edge mounting. These modules contain seven 0.014″ (0.36-mm) diameter print wires in a 2.2″ high x 4.25″ deep x 0.380″ wide (5.6 x 10.8 x 0.965-cm) module. A version with the cartridge plane perpendicular to the print row vertical axis and a 0.440″ (1.118-cm) stacking depth is planned. Version 678 will mount on vertical pin locators at the carriage or bed ring assembly of the user's equipment. Model V for edge mounting has 0.280″ (0.711-cm) row centers; model H for horizontal mounting has a minimum vertical displacement of 0.300″ (0.762 cm). Both will be available in 6-, 7-, and 8-wire complements.

Engineering samples are priced at $450/unit in quantities of 10 or less. Production models will range in price from $96 to $45 each, depending on quantity and multiple unit array.

—Peg Killmon, Senior Editor

Circle 272 on Inquiry Card



Cartridge modules developed by Baudex mount vertically on 0.280″ centers in any descending displacement. Used in this configuration, the dot matrix printheads can achieve high quality multiline single-pass printing

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CD10

CIRCLE 72 ON INQUIRY CARD

PERIPHERALS

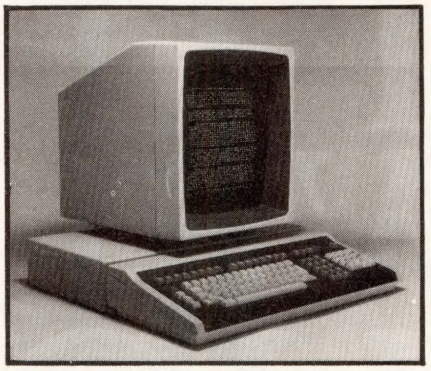
Complete ANSI control functions implemented on full-page terminal

A smart terminal, the PM 2010 has many of the features specified by the ANSI X3.64-1979 standard. ROM based software in the terminal defines limits and extensions to the standard, resulting in a coherent control function structure. Terminal features include a full-page 66 x 80-character display (see the photo), definable screen attributes, 8k-byte ROM, downloadable 32k-byte RAM (128k/256k optional), three accessible 8-bit configuration switches, two RS-232-C ports and one parallel port, and a movable keyboard with 50 keys beyond standard ASCII with an independent key controlled bit. Ten transmission rates between 75 and 19.2k baud are switch or software selectable. The 8086 based terminal is manufactured by Piiceon Inc, 2350 Bering Dr, San Jose, CA 95131.

Plug compatible with any host that supports standard ASCII terminals, the features on the PM 2010 allow users to define their own terminal characteristics. The full-page (66-line) display supports large form design and, by optionally sacrificing two lines, a status display for messages, keystrokes, commands, and screen position. The ANSI X3.64 graphic renditions concept is interpreted so that screen areas can be video reversed, intensified, made to blink, or underlined, or be any combination of these.

The large RAM and ROM allow software to automatically gain control at power-on or reset, while providing the flexibility of custom software downloading from the host machine into terminal RAM. The download process uses the ANSI X3.64 device control string concept and the standard Intel load format for transmission. Furthermore, this customization process is facilitated by a jump table, initialized in RAM by the ROM software, that allows any or all important functions it implements to be selectively replaced by downloaded functions.

Escape and control sequences include the ability to define fields with multiple



scrolling and to partially transmit displayed data. Also, with host OS and application programs running, a user can communicate to the OS, the application program, and another terminal without interrupting any of the other operations. User control of various PM 2010 configuration variables, such as screen size, host-link baud, key click, and block mode, is gained through the configuration switches. Most of these (eg, port baud) are polled continuously while some (eg, screen size) have effect only when powering up or hitting the RESET button.

A multiple communications port feature allows communication on an interrupt basis to both a host computer and an auxiliary device, such as a printer. Bit rates and other transmission properties are independently set via the switches just mentioned.

The terminal's full-page video display utilizes a 7 x 9 dot matrix in a 9 x 15 field for attractive, easy-to-read characters. Any combination of 128 characters, including upper- and lowercase with descenders, can be displayed in high or low. The 107-key detachable keyboard consists of a full alphanumeric set, with N-key roll over. The keyboard also includes eight function keys, a numeric key pad, and various dedicated keys.

—Douglas Eidsmore, Senior Editor

Circle 273 on Inquiry Card

Alphanumeric/graphic terminal executes graphics instructions locally

The VT125, an extension of VT100 and VT105 video terminals, displays pictures and shapes, plotted trend lines, bar charts, pie charts, point-plot graphs, and continuous data plots. In graphics mode, the unit supplies 768 x 240-pixel resolution using two graphics planes. It has 5k of user defined graphics program memory and 3k for user defined character sets. Although the 12″ (30-cm) display is monochromatic, the terminal displays four separate colors on an external monitor when in graphics mode.

In the terminal, Digital Equipment Corp, Maynard, MA 01754, incorporated a microprocessor that enables it to locally execute the Remote Graphics Instruction Set (ReGIS). Using this set, pictorial data can be created and stored as simple ASCII text. Commands from the set can be inserted into programs written in BASIC, COBOL, FORTRAN, or DIBOL languages.

With ReGIS commands, a user can draw on the screen using lines, text, circles, and curves. Graphics and text can be displayed together. The instruction set provides for either absolute or relative positioning of text and pictures. Characteristics such as variable height and width, italics, shading, and overlays can be assigned to text and pictures to add emphasis or variety to displays.

Although the terminal's display is monochromatic, it provides for output to a slave color monitor that displays four separate colors out of a possible 64. Through graphics shading techniques, these four colors can be combined to produce images that appear to have additional colors. An RS-232 port is intended primarily for output to the LA34-VA graphics printer which will produce monochromatic hardcopy of the screen with the same levels of shading.

The terminal is priced at $3800. Kits to convert VT100 or VT105 (VT1XX-CB and VT1XX-CL, respectively) are $2000.

Circle 274 on Inquiry Card

GIMIX & MICROWARE present the 6809 PROFESSIONAL TOOLBOX

A **GIMIX** 56KB static RAM 2Mhz 6809 Dual Drive Mainframe System with **MICROWARE's** Multiuser OS9 Pro-Package --special combination price **$3968.09.** This system includes the **GIMIX** Mainframe with 30 amp C.V. ferro-resonant power supply, SS50/50C Motherboard, 2Mhz 6809 CPU with time of day clock and battery back-up, 6840 programmable timer, 2 serial ports, 56K Bytes of Static RAM, and two 5¼'' disk drives and double density controller installed in the **GIMIX** Mainframe with the same brownout protection and power supply reliability that **GIMIX** is famous for.

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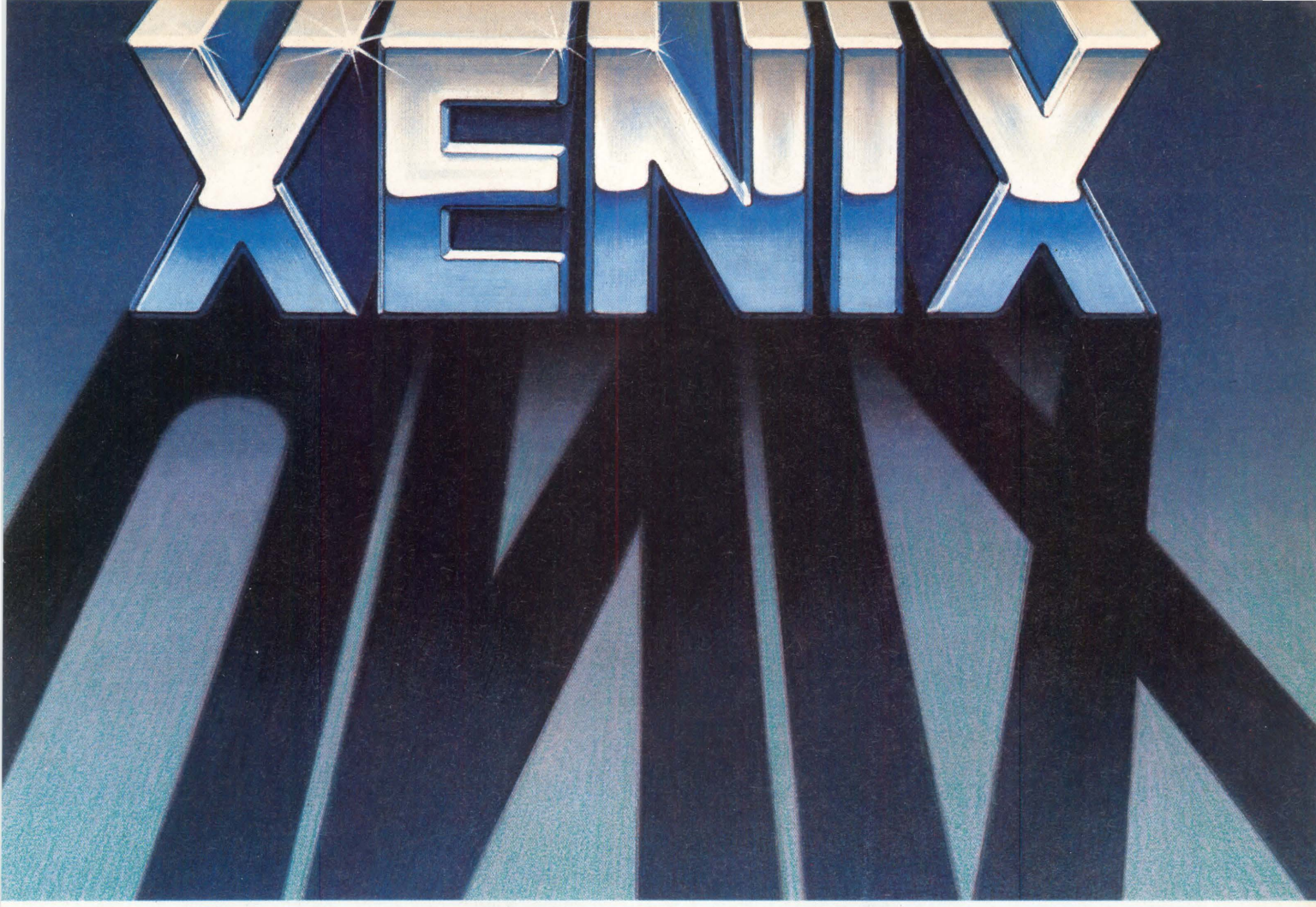
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CIRCLE 73 ON INQUIRY CARD



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Setting the standard. XENIX is Microsoft's implementation of the UNIX* operating system. It's a multi-tasking, multi-user OS for leading 16-bit microprocessors. In fact, XENIX is such a productive, portable system, that we expect it to become the de facto standard operating system for 16-bit microprocessor-based systems. A standard that will foster the development of applications programs that sell systems.

Support. XENIX is fully supported by Microsoft. In developing XENIX for 16-bit microprocessors, we improved the efficiency of the UNIX operating system. Then, we added enhancements specifically designed to make the system suitable for the commercial marketplace. You can create a total environment by adding Microsoft's standard software packages to the XENIX operating system. In languages, Microsoft's BASIC Interpreter and Compiler, FORTRAN, COBOL, and Pascal provide unique program portability between 8-bit and 16-bit systems. And, Microsoft is the single-source vendor for the XENIX operating system, languages and utilities. In addition, Microsoft's XENIX Clearinghouse will provide access to a library of XENIX applications software and utilities.

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*UNIX operating system is a trademark of Bell Laboratories
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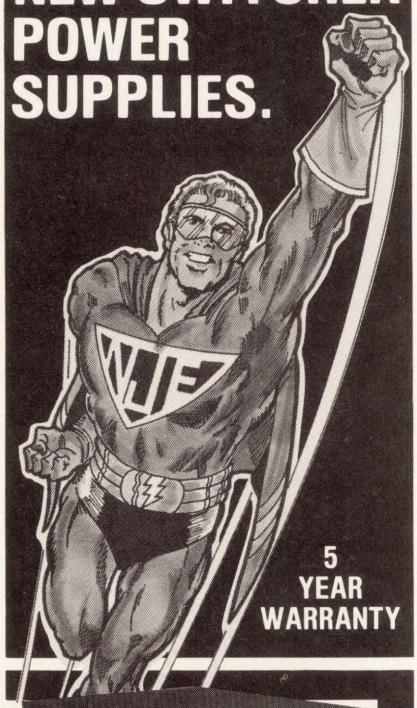
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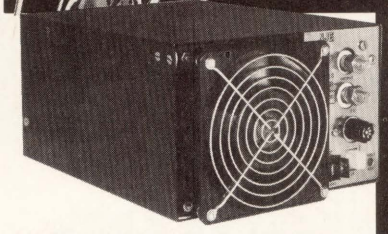
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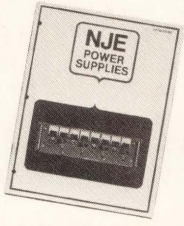




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PERIPHERALS

Interactive graphics workstation and software ease 3-dimensional design

An interactive 3-dimensional design workstation and complementary engineering/drawing software have been introduced by Lundy Electronics & Systems, Inc, Glen Head, NY 11545. The hardware/software combination is designed for mechanical design, mapping, architecture/engineering construction, IC, PCB, and other design applications.

UltraGraf™ workstation contains a 16-bit bipolar bit slice microprocessor that uses pipeline processing and dual bus architecture. It handles 32 display command instructions and has a 48-bit microinstruction word size. ROM is expandable from 1k to 4k words in 512-word increments. Cursor control is by lightpen or other cursor control device. Local transformations include 3-D, translate, scale, windowing/clipping, rotate, and zoom. The workstation has up to 128k words of buffer and refresh memory.

Local intelligence in the workstation enables the performance of a wide range of design functions without having to call on the mainframe. A 21″ (53-cm) vector refresh display and 0.01″ (0.25-mm) spot size give the operator a comfortably large viewing area with fine line definition. Screen resolution is 4k x 4k x 4k within a 32k x 32k virtual map.

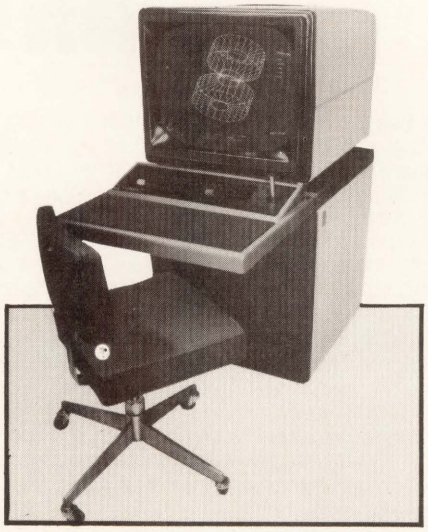
Dual buffering is locally controlled giving instantaneous screen refresh that allows the display to be refreshed from one memory while the other is being loaded with new data. Dynamic displays such as rotation or scrolling proceed in a smooth continuous motion. The workstation maintains a direct relationship in 3-D geometric data between the image displayed on the screen and information stored in the data base. Rasterization calculations required to generate electrostatic hardcopy printouts up to 42″ (107 cm) are performed within the workstation. The unit is compatible with most 16- and 32-bit microcomputers.

FORTRAN-written UltraGrafics™ software is a computer aided design/manufacture (CAD/CAM) interface package that takes full advantage of integrated distributive processing to reduce mainframe intervention. It thereby speeds 3-D design analysis and provides local user interaction in creating or modifying drafting designs.

The package exhibits a true 3-D device independent, real number (floating point) data base. Because identification tags for each entity in the workstation buffer memory correlate to the appropriate locations in the stored data base, direct access techniques can replace slow sequential database scanning to find stored related entities.

Drawing options include orthogonal and defined nonorthogonal planes in Cartesian, spherical, cylindrical, or polar coordinates. Among the designer construction features are point definition with lightpen detect, absolute and delta coordinates, intersection of two elements, projection onto elements from lightpen detect, and equal increments along individual elements. Calculation functions cover intersection of elements, lengths, arcs, points of tangency, and 3-D entity reorientation and location.

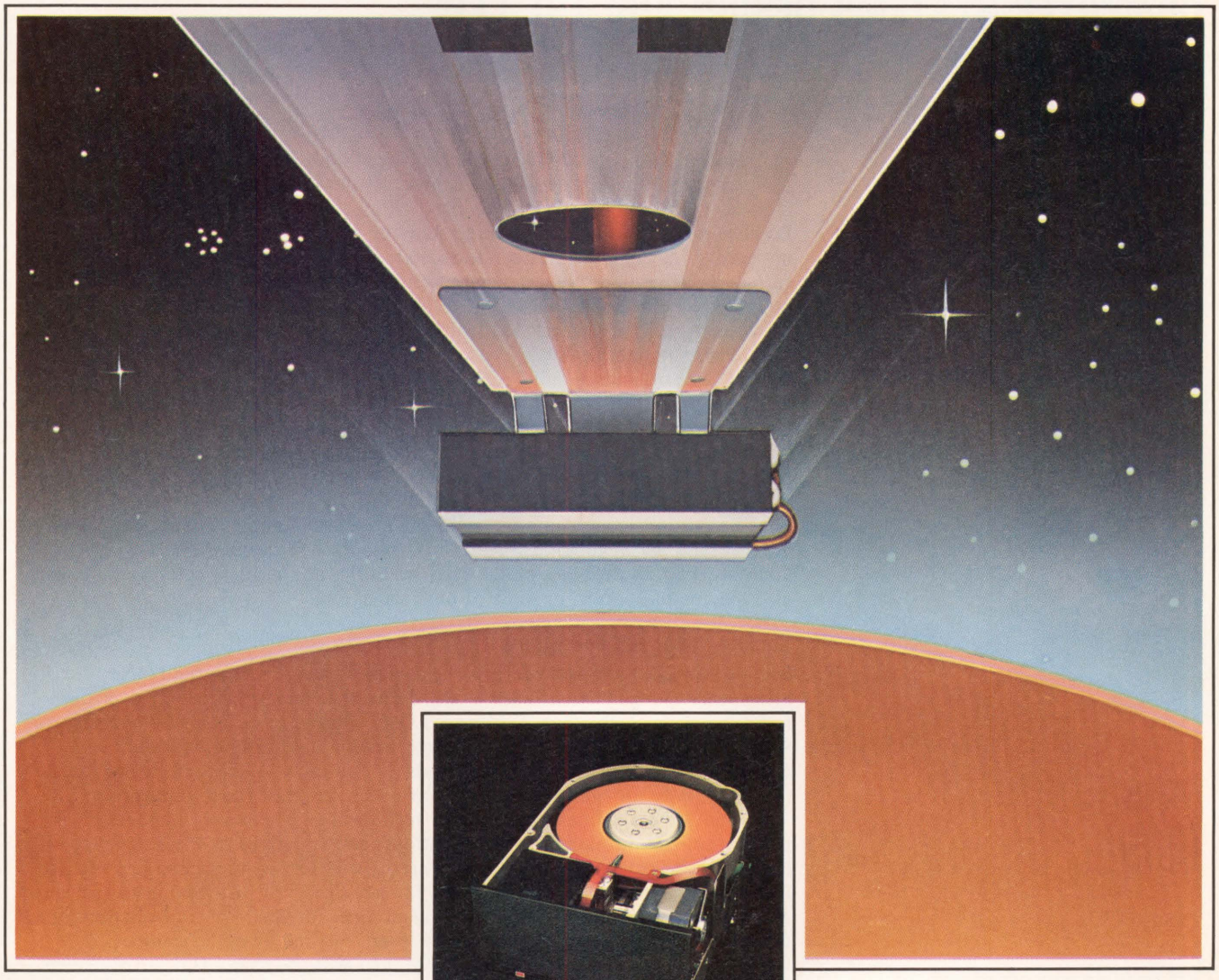
The graphics hardware/software is particularly useful for major industrial applications where the data base is placed in host processors and the interactive graphic workstations are located in clusters around satellite CPUs.



UltraGraf graphics design workstation. Standard configuration includes lightpen to define areas, locate positions, and select instructions, plus standard function keyboard. Options include alphanumeric keyboard, joystick, dial box, and graphics tablet/digitizer. Display has 19″ x 15″ (48 x 38 cm) viewing area

Circle 275 on Inquiry Card

Thin is in!



Seagate Technology announces another first. The inventor of the 5¼-inch micro-Winchester™ now brings you thin film heads and 12.76 megabytes on just two platters — double the capacity of current ferrite head drives.

The new ST512 micro-Winchester with thin film heads stores 10202 bits per inch and doubles the number of tracks from 612 to 1224. Increased bit packing permits recording closer to the disc center and eliminates the need for write precompensation.

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CIRCLE 75 ON INQUIRY CARD

COMPUTER SYSTEMS DESIGN AND THE LAW

Saul B. Dinman

As readers of *Computer Design* know, the FCC regulations on electromagnetic interference (emi) generated by computing devices went into effect on October 1. Common to most such regulations, they are written in governmentese. Because we at *CD* feel that an understanding of these emi regulations is imperative for computer system designers, we have attempted to translate the formal directives into plain language. Although we believe our interpretation to be correct, we make no claims for absolute accuracy. The information was pieced together from what was gleaned from the document containing the Regulations, plus telephone interviews with FCC engineers at the Boston field office and the FCC's Office of Science and Technology in Washington.

The document of concern is Volume II of the FCC Rules and Regulations, which can be purchased for $21.00, with an unlimited subscription to all updates, at least until the FCC feels the need to reprint the whole volume. This volume may be ordered, as noted in the *CD* September "Up Front," from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Specific portions concerning the emi issue are Parts 2 and 15. Part 2 deals with general rules and regulations of the FCC while Part 15 deals with rf devices. In addition, Part 18 deals with industrial, scientific, and medical equipment, which also may be of concern to some of our readers.

Some general FCC definitions

Section 15.4(a) through (c) defines the scope of radiation that the FCC is attempting to regulate. Included is any device that radiates rf energy over the radio spectrum, defined as 10 kHz to 3 GHz. Furthermore, *harmful interference* is defined as any radiated signal that interferes in any fashion with radio communications or radio navigation aids. It also includes *all* devices that radiate rf energy, even though they may not have been designed for that purpose.

Section 15.4(e) defines marketing of such devices. The word "marketing" is used repeatedly throughout the Regulations, and is defined as the attempt to sell, lease, or distribute equipment, by any means whatsoever, to an *end user*. It also includes the importation of equipment for sale, lease, or distribution to end users as well as advertising or offering such equipment for sale, lease, or distribution. It does *not* include equipment that is sold to an OEM for manufacturing or fabrication into a system which the OEM then sells or leases. This last statement is important because it appears to exempt the OEM supplier, placing the burden on the OEM manufacturer who ultimately sells a system to an end user. By our interpretation, if you manufacture a subsystem component that never finds its way into the hands of an end user directly from your company, it is your customer (the OEM who incorporates that product into a finished system that is then sold to the end user by the OEM) that the FCC defines as the marketer.

Computing devices according to the FCC

Section 15.4(n) contains the first reference to a computing device, any device that generates and uses timing signals in excess of 10 kHz and uses digital techniques. It includes everything you or I can think of in the way of terminals, printers, disc drives, CPUs, digital clocks, smart telephones, and the like. Note that it does *not* include components or subassemblies such as power supplies (switching or not) or display assemblies. It also excludes devices that may use digital techniques but are covered under separate regulations because of their applications, such as radio transmitters and industrial, scientific, or medical equipment that are designed to radiate ultrasonic or rf energy.

Classes of computing devices

Section 15.4(o) defines a *Class A* computing device as any computing device marketed for use in commercial, industrial, or business applications;

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CIRCLE 76 ON INQUIRY CARD

it specifically excludes devices marketed for use by the general public, for use in the home. In Section 15.4(p), a *Class B* computing device is defined as one meant for use in a residential environment even though it may *also* be intended for commercial, industrial, or business environments. Class B includes devices such as electronic games, personal computers, and calculators marketed for use by the general public. In other words, that small computer your stock broker has in his office and the identical unit that you bought to keep track of your calorie intake is a Class B device.

The first of the "Catch 22" situations appears here, with the statement that the Commission has the option to reclassify any Class A device as a Class B device if it finds that the device *repeatedly* causes harmful interference, even if the device is not intended for Class B use. It should also be noted that the Commission encourages all manufacturers to qualify devices as Class B simply because of the more stringent emi requirements.

The personal computer vendetta

Just to make certain that a Class B computer is not mistaken for a Class A unit, the Commission has entered a special Section, 15.4(q), which clarifies the distinction. Suffice it to say that most who read this do not need further clarification on the subject. A *reductio ad absurdum* section was added by the Commission in which it will listen to a plea for Class A status if the manufacturer can demonstrate that the price or performance of the computer is not suitable for residential or hobbyist use. This clause probably will disappear as the trend continues toward more performance for less money.

The essence of verification

Section 15.4(r) defines the FCC's *verification* procedure as the manufacturer or importer performing tests that ensure that the equipment meets the technical emi requirements of Part 15. The unit tested should be representative of all future production units. Furthermore, the FCC requires the manufacturer or importer to maintain records that show what steps were taken to ensure that each device sold complies with the emi requirements.

Plugging the peripheral loophole

Just to make sure that peripherals which are often used on Class A as well as Class B devices don't slip through the Class A door, the FCC specifically defines Personal Computer Peripheral Equipment in Section 15.4(s). Any peripheral device that can be connected to a personal computer by cable and is marketed for home use is a Class B device. Again an out for price or performance unsuitable for residential or hobbyist use is offered to the manufacturer.

The door to door search

The FCC does have the right to enter premises that it suspects are emitting rf radiation. Such inspections happen frequently to amateur radio operators who ignore their neighbors' complaints about interference to TV reception. Now, according to Section 15.5, it can happen to

$595?



$595!

Yes, it's true.

The best selling terminal in its class now has the best price in any class.

That's the only way we could've improved our Dumb Terminal™ video display. We had already done everything else so well that the Dumb Terminal was renowned the world over. With over 150,000 shipped, and more on the way every day.

So now you can buy the ADM 3A for a mere $595 (quantity one), and the ADM 5 for a paltry $645. But don't let the price tags fool you. They're the same, dependable Dumb Terminals they've always been. We didn't change that.

The ADM 3A still has all the same reliable features that made it a best-seller. And the ADM 5 has even more operator conveniences. Like reverse video, reduced intensity and reverse video/reduced intensity. Limited editing with erase to end of line and erase to end of page (which reduces the load on your host computer). A gated extension port. Even a full integral

you, the manufacturer, or to your customer. Also, the FCC expects to find on the premises all documentation such as labels, notices, or any technical data that the operator of the device is required to keep on file. Section 15.5 further states that the operator (your customer) must furnish the FCC with information it desires concerning the operation of the device. Presumably this includes cooperation in operating the equipment under FCC direction while measurements of radiated rf are being made.

Part 15, Subpart J: just for us computer people

Section 15.801 starts with a basic description of rf energy radiated into space by a computing device as well as rf energy conducted back into the power line that can cause harmful interference to radio communications. It also states that Subpart J conditions must be met before marketing of such devices is allowed. Furthermore, 15.801(c) specifically exempts four computing applications pending final resolution of current proceedings: computing devices used in transportation vehicles; electronic control or power systems used by public utilities or industrial plants; industrial, commercial, or medical test equipment; and computing devices used in appliances (ovens, dryers, dishwashers). All of these applications are, however, subject to 15.803, but not to any of the provisions of the rest of Subpart J. A kind word of FCC advice is then added that states the manufacturer is strongly urged to have devices meet all of the limits stated in Subpart J.

You cannot interfere

Section 15.803 states that whether or not there is compliance with Subpart J, the FCC can require the operator of a computing device (the customer) to stop operating that device if the Commission finds that it causes harmful interference and is in the public interest to stop operating until the interference problem is solved. A herringbone tweed pattern on your neighbor's TV set whenever you balance your checkbook on your personal computer well might be construed as harmful interference.

The first label requirement

Section 15.805 requires that all Class A or B computing devices manufactured after January 1, 1981, that have not been verified as complying with emi standards, carry a label permanently attached in a conspicuous location that states:

"This equipment has not been tested to show compliance with the new FCC Rules (47 CFR Part 15) designed to limit interference to radio and TV reception. Operation of this equipment in a residential area is likely to cause unacceptable interference to radio communications requiring the operator to take whatever steps are necessary to correct the interference."

A similar but longer statement should also be placed in the instruction manual. If the equipment is verified in accordance with the provisions of Part 15 prior to the mandatory dates, this step can be skipped.

Pollution levels

Class A radiation limits are stated in

numeric keypad. And they said it couldn't be Dumb.

So there you have it. The same two proven Dumb Terminals, two new low prices to save you even more money.

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DATA PRODUCTS DIVISION

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$645!

15.810. These are the maximum allowable levels from a typical system configuration, which includes all cable and peripherals attached to it as they would be in actual use.

Measured at a distance of 30 m

Frequency (MHz)	Field strength (μV/m)
30 to 88	30
88 to 216	50
216 to 1000	70

The tighter limit applies at the edge between these frequency bands.

In section 15.812 the maximum rf level allowed to be conducted back into the power line attached to the system is defined:

Frequency (MHz)	Max rf line voltage (μV)
0.45 to 1.6	1000
1.6 to 30	3000

The tighter limit applies at the band edge. A warning is also issued that limitations are currently being considered in the 10- to 450-kHz range.

Class A computing devices verified

Section 15.814 requires that a Class A device that is *first* put into production *after* October 1, 1981, must be verified for compliance with Class A radiation limits before it can be marketed, which is all new equipment that goes into production for the first time after October 1, 1981. *After* October 1, 1983, *all* Class A equipment, *regardless* of when it first went into production must be verified for compliance. Certification (that's where the FCC wants you to file your actual test data along with an application) is not required for Class A equipment. *But,* the Commission reserves the right to require additional testing and, if they decide it best, to require certification of Class A equipment.

In any event, if Class A equipment is found to be the source of harmful interference, it may be necessary to comply for all equipment before the final date of October 1, 1983.

The next label

After verification procedures are successfully completed, a new label is required as specified by Section 15.816. Again the label must be in a conspicuous place and contain the following statement:

"This equipment complies with the requirements in Part 15 of FCC Rules for a Class A computing device. Operation of this equipment in a residential area may cause unacceptable interference to radio and TV reception requiring the operator to take whatever steps are necessary to correct the interference."

Systems incorporating peripherals need have only one label on the main control unit. If, however, peripherals are marketed separately, and verified for Class A compliance, a similar label is required on the peripheral. This label reads as above except for an added statement that says "See instruction manual." The instruction manual contains an amplification of the basic label statement and also includes a statement worth noting:

"...Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference."

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ADM 31. LOADED WITH FEATURES.

The ADM 31 Intermediate Terminal™ comes standard with full editing and formatting, two pages of memory (a total of 48 display lines), printer port and a complete range of visual attributes.

That wasn't enough for us, however. It also features a high resolution monitor with a choice of white or green display. Built-in numeric keypad. Function keys. Block mode transmission. Modifiable personality that lets you choose any combination of terminal operations (transmit carriage return, line feed at end of every line instead of CR code, etc.). Polling for more efficient use of computer time and transmission lines. Business graphics. And for a mere $50 extra, we'll throw in programmable function keys, 25th status line and smooth scroll.



ADM 32. EVEN MORE FEATURES.

The ADM 32 Ergonomic IT™ has all that, and is engineered to make you even more comfortable. Because comfort and ease increase productivity. So, in addition to the ADM 31's attributes, the ADM 32 gives you as standard

$1095.

The instruction manual for a Class A peripheral is also expected to contain sufficient information about connection to a system to ensure that the whole system, cables and all, meet the Class A requirements.

Class B pollution levels

Class B radiation limits are defined in Section 15.830 and are the maximum allowable levels radiated from a typical system configuration, including cables and peripherals, marketed by the manufacturer:

Measured at a distance of 3 m

Frequency (MHz)	Field strength (μV/m)
30 to 88	100
88 to 216	150
216 to 1000	200

Tighter limits apply between band edges.

Section 15.832 sets the conduction limits for Class B equipment to not more than 250 μV/m over the frequency range of 450 kHz to 30 MHz.

Class B computing devices must be certificated

Section 15.834 sets a compliance requirement for all Class B devices that is quite different from the verification requirement of Class A devices. This section states that Class B computing devices shall be *certificated* if they were placed in production after January 1, 1981, prior to marketing. This includes electronic games (including coin operated games), personal computers as defined in 15.4(q), and personal computer peripherals.

Strictly speaking, all of the home computing equipment should have been certificated and carrying appropriate labels since the beginning of 1981. The FCC has been deluged with applications for variances, postponements, and exemptions, resulting in rather lenient enforcement on the part of the Commission. Many of the Class B manufacturers seem intent on fighting regulations to the bitter end rather than attempting compliance. Perhaps some of the old line computer companies entering the Class B arena with fully certificated equipment will spell a quick end to the delaying tactics.

The rules continue, describing various exceptions that have been made for certain types of games, calculators, clocks, and watches.

The Class B labels

After certification all Class B computing devices must carry a permanent and conspicuous label according to Part 15.836. The label states:

"Certified to comply with the limits for a Class B computing device pursuant to Subpart J of Part 15 of FCC Rules. See instructions if interference to radio reception is suspected."

Furthermore, Part 15.838 requires the manufacturer to supply the user with information on the possibilities of interference and to suggest some simple measures that the user can take to attempt correction of interference. This information must be contained in the user manuals supplied with the equipment; a suggested wording is given in 15.838(b).

Complete systems must be tested

Rest assured that even if a computer manufacturer purchases a peripheral or a power supply from another manufacturer, the system manufacturer will be responsible for verifying that *typical* use of that system does not generate rf levels

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that exceed the stated maximums. This means that testing must be done with a typical assortment of peripherals attached to the equipment with lengths of cables that would normally be used between equipment. This also implies that the system manufacturers should choose peripherals that are either verified or certified by their manufacturers so as not to be saddled with someone else's problems. The definitions of marketing equipment mentioned earlier (Section 15.4) will place the burden on the distributor or dealer that chooses to mate unacceptable peripherals with verified equipment. In conversations with FCC engineers in Washington, it was mentioned that in cases where systems are typically distributed over large areas where lab testing of such a typical configuration would be impractical, the Commission will accept data taken from three typical live installations of the equipment as verification. Obviously, it is easier to test equipment in the controlled environment of the laboratory, but this may be impossible for system integrators who are marketing widely dispersed systems consisting of equipment from many different manufacturers. In such cases the major source of radiation that the system integrator will have to deal with may be the interconnecting cables.

When in doubt, ask

These FCC Regulations are subject to much interpretation, as are most legal documents. The interpretations will probably vary even among FCC officials and common sense would dictate that interpretations be obtained from more than one source. Besides the FCC officials, many emi consultants are available who can help not only with interpretations, but even with curing ailing equipment. Most such consultants have been practicing "emi hardening," as they call it, on military equipment which has much stiffer emi regulations than the ones we are dealing with here. Many of these consultants also offer complete testing facilities in FCC certified test ranges. It would seem that the smaller company faced with having to comply would do well to utilize such services rather than to rush into purchasing a lot of expensive equipment that may be improper or require experienced personnel to operate. □



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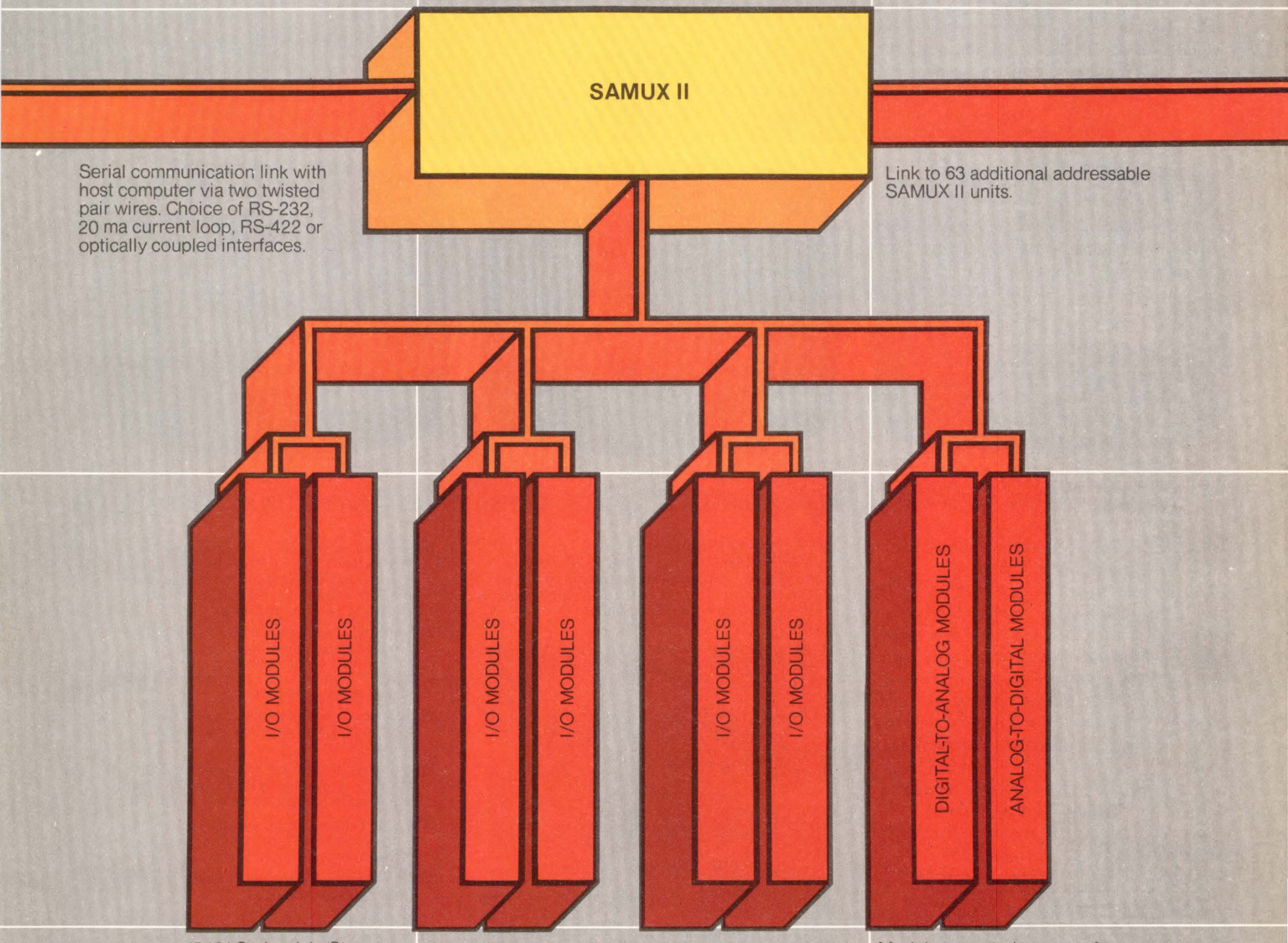
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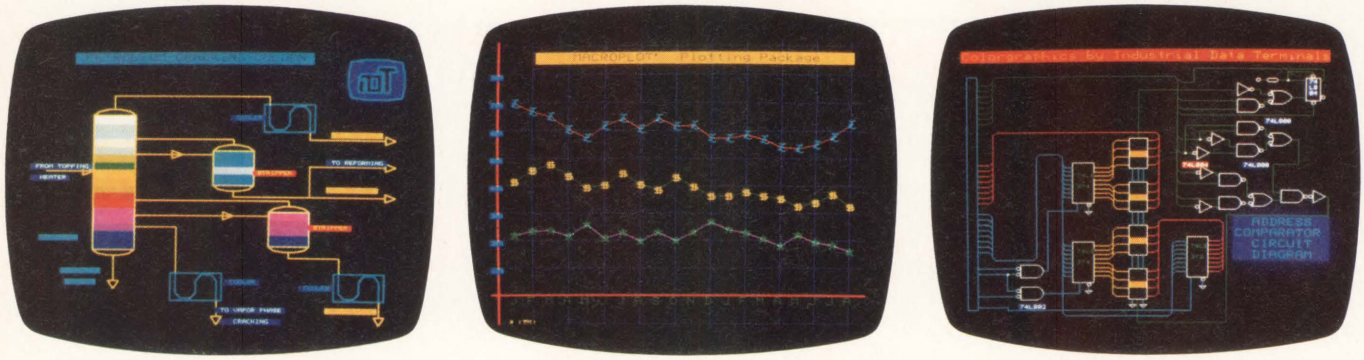
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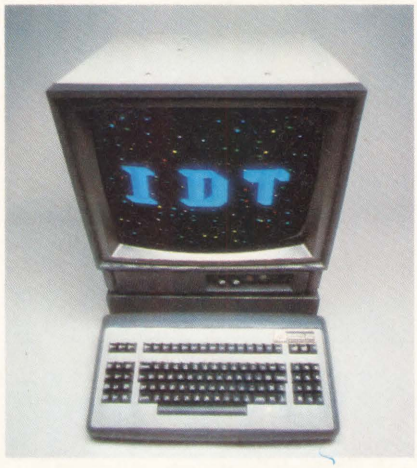


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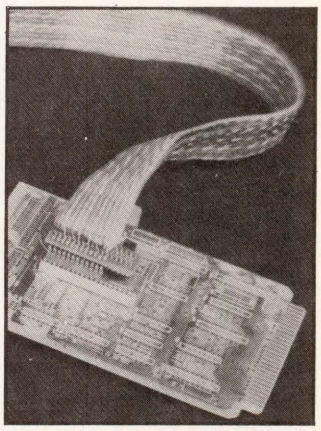
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CIRCLE 81 ON INQUIRY CARD

IN-SITU EMULATION PACES NEW MICROS

Evolutionary development improves accuracy of simulation by moving the target processor closer to the application



by David McCracken

Support for microprocessor application development must grow rapidly to keep up with advances in very large scale integration technology. The increasing speed and complexity of semiconductor devices have especially taxed in-circuit emulation, which strives to accurately simulate the functional and electrical characteristics of a microprocessor. Present in-circuit systems position the target microprocessor as much as several feet away from the application circuit. Buffer devices separate it from the application electrically. The physical and electrical separation of microprocessor and application circuitry makes conventional in-circuit emulation a less adequate way than ever to simulate semiconductor devices.

Following the current trend toward moving the target microprocessor closer to the application, in-situ emulation meets the requirements of very large scale integration (VLSI) simulation by placing the microprocessor directly in the application physically and, as much as possible, electrically. This often requires hybrid microcircuits to reduce the size of buffer and control circuitry, producing an emulation plug that can comfortably fit into most applications. However, the concept is initially demonstrated with a Z8™ in-situ emulator that has been built using standard integrated circuits (ICs), as only two ICs are needed for cable driving buffers in the emulation plug. The Z8 resides physically in the application with no buffering, producing complete electrical transparency.

David McCracken is a microprocessor applications consultant and principal engineer at Thera Institute, PO Box 1090, Aptos, CA 95003. His design work includes automated laboratory equipment for biochemical research, multiprocessor controlled test environments, and miniature computerized field data acquisition systems. He was also an industrial control systems consultant. Mr McCracken studied civil engineering at the University of California, Berkeley.

Challenges of in-circuit emulation

In-circuit emulation (ICE) basically time-multiplexes a target device between development and application environments. The target microprocessor communicates with a host computer while in the development environment, performing program development functions specified by the operator, such as beginning execution at a particular address or sending breakpoint information for use in a display assembled by the host. While in the application environment, the target executes programs that are being developed, interacting only with the application hardware.

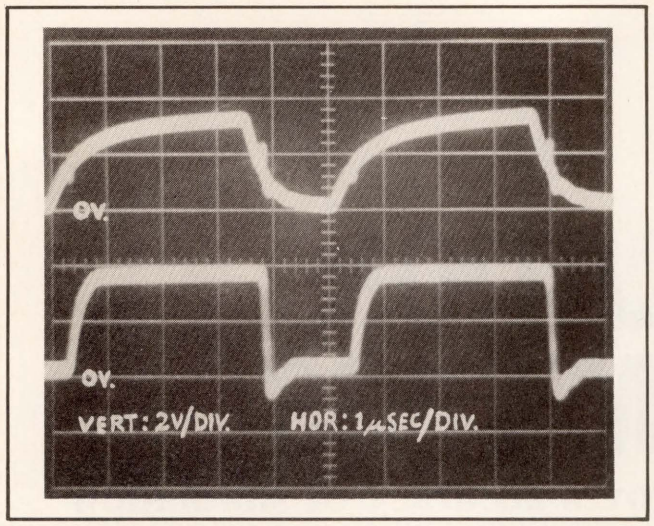


Fig 1 Effects of emulation. Oscilloscope trace at top shows Z8 output port driving highly capacitive load. Bottom trace shows typical ICE circuit driving same load through TTL buffer and short length of twisted pair. Its undershoot below 0 V can damage circuits

Transparency of emulation, or the degree to which the target microprocessor in the development environment resembles an unattached application, must be measured in both functional and electrical terms. Functional transparency has generally been achieved to a high degree through various implementations of memory bank switching so that development programs reside only in the target's virtual address space and need not impinge on actual potential facilities.[1] Electrical transparency, however, has generally not been achieved because target microprocessors have been separated from the application both physically [up to several feet (± 1 m)] and electrically by buffer devices.[2] The resulting signal delays and inaccurate drive/load simulations have not been an overwhelming problem in most situations because, until recently, most microprocessors operated at speeds low enough so that the signal delays became unimportant, and bus-oriented microprocessors usually are buffered in the application by devices similar to those used in the ICE circuitry.

Now, VLSI technology challenges traditional ICE electrical non-transparency in two major respects. One is that the operating speeds of new microprocessors are entering regions where transistor-transistor logic (TTL) buffer delays become significant, especially when combined with signal delays through the connecting ribbon cables. The other is the proliferation of increasingly complex single-chip microcomputers for which electrical, as well as functional, simulation is complicated. Metal oxide semiconductor I/O ports are particularly difficult to simulate using remote, cable-driving TTL devices. With more specialized functions, such as analog to digital conversion, moving into increasingly dense microcomputers, present emulation techniques may not be able to provide adequate simulation.

Depending on the electrical characteristics of a particular application, the accuracy of present ICE simulation varies. The oscilloscope display in Fig 1 demonstrates several of the problems. The top trace is created by a Z8 output port driving a 0.01-μF capacitive load directly, as it would in an actual application. The bottom trace is produced by a typical ICE circuit with a TTL buffer driving a 1.5-ft (46-cm) twisted pair into the same application environment. Beyond obvious differences in waveforms, a particularly troublesome phenomenon is the voltage undershoot caused by impedance mismatches between buffer, cable, and application circuitry. In some cases, the signal excursion below zero volts could damage devices in the application, but this would not happen outside the development system. Impedance mismatch problems will increase as ICE speeds rise to accommodate faster VLSI microprocessor targets. Possibly the only reasonable solution is the use of line drivers and receivers at both ends of the cable so that whether or not the target microprocessor is located *in situ,* some active circuitry must still be located in the emulation plug.

Evolution of in-circuit emulation

The problems posed by VLSI are not new to ICE. Increasing microprocessor speeds, in particular, have prompted steady change in emulation methods. In first generation hardware [Fig 2(a)], the target processor was located inside the development station, with a relatively short ribbon cable leading to the application microprocessor socket. Originally, the target processor accessed program memory (as well as other development facilities) through the main system bus shared with a host processor. The host moved programs that were to be tested into system memory under operator direction. It then relinquished bus control to allow target access to the memory. Unfortunately, this memory was often not fast enough to test program execution in real time, especially when faster microprocessors became available. Also, in some designs, the host lost much of its system control while emulation proceeded, and the target microprocessor, having control of the main bus, could cause system crashes by improperly accessing program development and control facilities. These problems were mostly solved by using a 2-port memory, accessed separately by host and target, and dedicated to emulation.

As microprocessors continued to increase in speed, and as development system users began to demand more flexible hardware, ICE designers moved the target processor into a buffer/adapter pod located in the cable between the development station and application system [Fig 2(b)]. This move required much more complex ICE

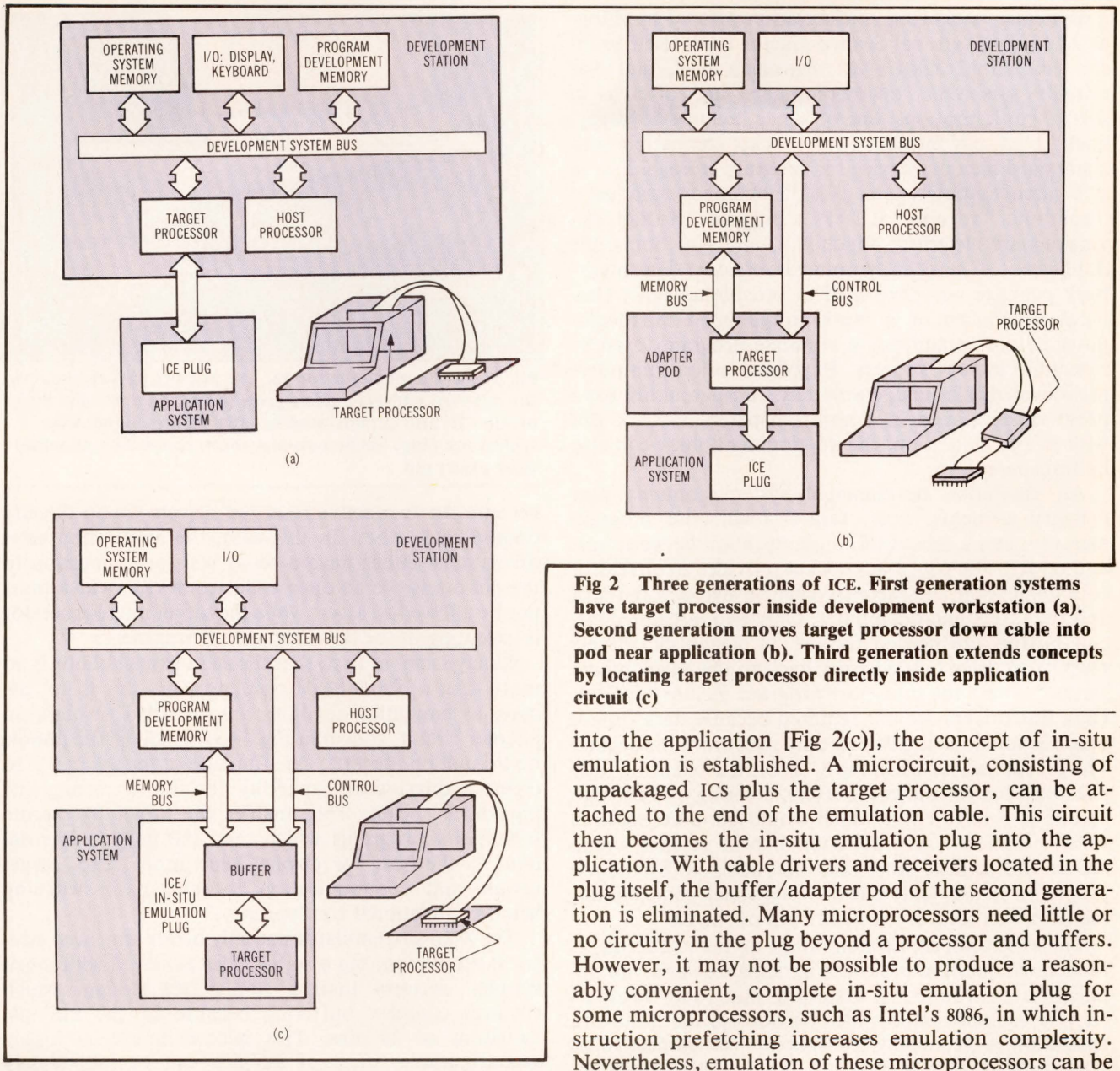


Fig 2 Three generations of ICE. First generation systems have target processor inside development workstation (a). Second generation moves target processor down cable into pod near application (b). Third generation extends concepts by locating target processor directly inside application circuit (c)

circuitry, with both memory and target control signals delivered to the buffer/adapter from the host through another ribbon cable. However, the relatively small pod could be placed close to the application, reducing the effects of long cables on signal delay and impedance mismatches (even one extra foot of cable can severely aggravate problems caused by impedance mismatches). This second generation hardware has not dealt with electrical transparency in that buffers are still required between the target processor and application. In addition, application circuitry still must drive both the cable to the pod and the standard device loads within the pod, instead of the actual microprocessor.

To meet the challenges posed by VLSI in the form of greater speeds and unique functional and electrical characteristics of microcomputers, a third generation emulation can be extrapolated from the existing trend toward moving the target processor closer to the application. As the target processor finally moves directly into the application [Fig 2(c)], the concept of in-situ emulation is established. A microcircuit, consisting of unpackaged ICs plus the target processor, can be attached to the end of the emulation cable. This circuit then becomes the in-situ emulation plug into the application. With cable drivers and receivers located in the plug itself, the buffer/adapter pod of the second generation is eliminated. Many microprocessors need little or no circuitry in the plug beyond a processor and buffers. However, it may not be possible to produce a reasonably convenient, complete in-situ emulation plug for some microprocessors, such as Intel's 8086, in which instruction prefetching increases emulation complexity. Nevertheless, emulation of these microprocessors can be improved by active line drivers and receivers in the plug, even if the target must still be in a remote pod.

In-situ emulator

Because electrical transparency is especially desirable in single-chip microcomputer emulation, it will be used as the area to demonstrate the in-situ concept. In addition,

a particular packaging configuration offered by Zilog, Mostek, and National Semiconductor lends itself to in-situ emulation. Zilog's Z8[3], Mostek's 3870[4], and National's 8048/49/50[5] microcomputers are offered in several configurations, one of which includes a "piggyback" read only memory (ROM) socket compatible with a standard memory device for program storage. For its 8022 microcomputer, Intel calls the analogous product a "bond-out" version.[6] It lacks a piggyback socket. All versions are electrical, functional, and pin-compatible duplicates of mask-programmed versions. The piggyback package was developed to provide an exact electrical simulation of a mask-programmed microcomputer before committing a tentative program to an irreversible factory process. Piggyback microcomputers are intended as a final, electrically transparent test for a program developed in a non-transparent system. But with in-situ emulation, the development phase can also be transparent.*

An emulation development system contains four primary elements: host, target, read/write program memory, and a means of communication between host and target. The piggyback socket provides a convenient communication and memory channel between the host and the target microcomputer. Only two integrated circuit buffers are needed for the Z8 piggyback address outputs to drive twisted pairs back to the development station, where the dual-port program memory resides. Data line drivers are not required because data flow is unidirectional, as the Z8 can only read from the socket. The prototype, shown in Fig 3, is constructed using fully packaged ICs for the two buffers, creating a fairly high profile [0.8 in (2 cm)], which would be undesirable in some situations. A production hybrid version would reduce this to little more than that achieved by the ICE plugs now in use. Only one non-piggyback connection is required—to control the RESET pin of the Z8.

The RESET pin connection brings up for ICE designers the critical question of how to anticipate a variety of application environments, assuming that total transparency is virtually impossible. Obviously, the Z8 in-situ emulation is electrically transparent with respect to all pin functions other than RESET. But the RESET function, as well, can be made nearly transparent by anticipating the most practical application environments. This is not difficult, as the application RESET circuitry will take only two different forms. One is a standalone microprocessor configuration in which the Z8 is allowed to reset itself on power-up, using an external capacitor for time delay (all single-chip microcomputers have this function on the chip to reduce low-end product cost). The other is an external driver to synchronize with other devices in a multiprocessing configuration.

The emulator can anticipate the self-reset circuit simply by using a high impedance 3-state driver to control the pin. Then, during emulation, when the emulator controller need not exercise its reset control, the driver is placed in its high impedance state, allowing the application reset to function normally. In the second configuration—which is much less common—the application circuitry must be designed to accommodate the emulator

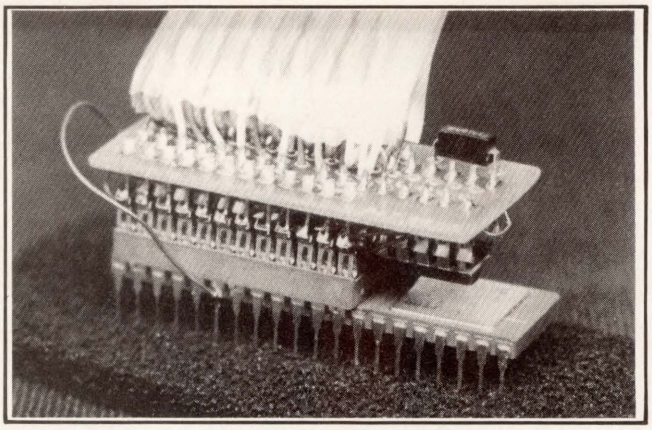


Fig 3 In-situ emulator for Z8. Use of fully packaged chips for onboard address buffers gives prototype unusually high profile. Hybrid circuits need be only slightly higher than typical ICE plug. Single non-piggyback connection attaches to Z8 RESET pin

because the two active reset pin drivers would directly oppose each other. In this case, the application reset driver must either have a series resistor connection to the pin or else be an open collector device, which must not be allowed to assert while the target microprocessor is executing in the development environment.

It may seem, at first, that the Z8 in-situ emulator is no more than a simple ROM simulator, but this is not the case, as emulation facilities are provided through an adapter circuit, shown in Fig 4 (right side of the double board unit on the left). One function of the adapter is to create a quasi-write capability for the Z8 through its piggyback socket. This enables the target to execute breakpoint programs which send the target's internal data to the host for display generation. Also, target restart and communication through bank-switching achieves functional transparency.[1]

The Z8 in-situ emulator not only offers improved electrical simulation, but also has been achieved with much simpler circuitry than a similar ICE design, which requires complex buffering because of the multiple functions of Z8 pins. This microcomputer is highly reconfigurable; most of its pins can be individually changed from input to output under software control. One final achievement is that this circuitry is compatible with Mostek's 3870 microcomputer, which provides the same pinout in its piggyback ROM socket. Thus, with no hardware changes other than connecting the cable to a different target processor, two different emulators can be produced. This in-situ emulator has one deficiency not found in second generation ICE. The Z8 can be reconfigured for external memory access through pins which would otherwise be I/O ports. With full control over all target pins, the ICE can provide substitutes for nonexistent application memory, which the in-situ emulator cannot. A complete development system could offer both forms of emulation.[6]

*Zilog has introduced a universal peripheral controller microcomputer with a piggyback package, the Z8090-UPC; Phillip's German subsidiary, Valvo GmbH, has introduced a piggyback series similar to the 8048 called the MAB8400.

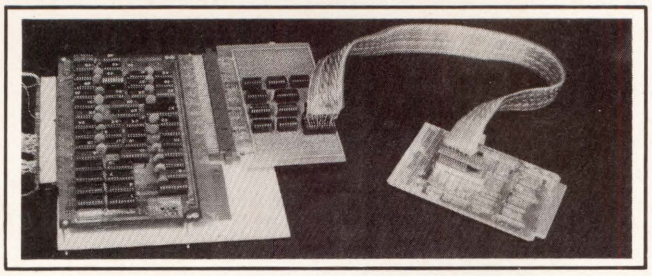


Fig 4 Prototype hardware for in-situ emulation. Complete system has emulation plug to replace application microprocessor (at right). Adapter circuit allows target processor to access dual port memory and channel for communicating with host

Summary

As accurate VLSI simulation demands increasing ICE performance, the evolutionary development of ICE design suggests placing the target processor directly in the application, creating in-situ emulation. This can provide the improved speed and signal quality required by faster processors and more accurate electrical simulation for single-chip microcomputers. Even where the complexity of microprocessors precludes the ideal in-situ form, active circuitry in the emulation plug will produce valuable improvements.

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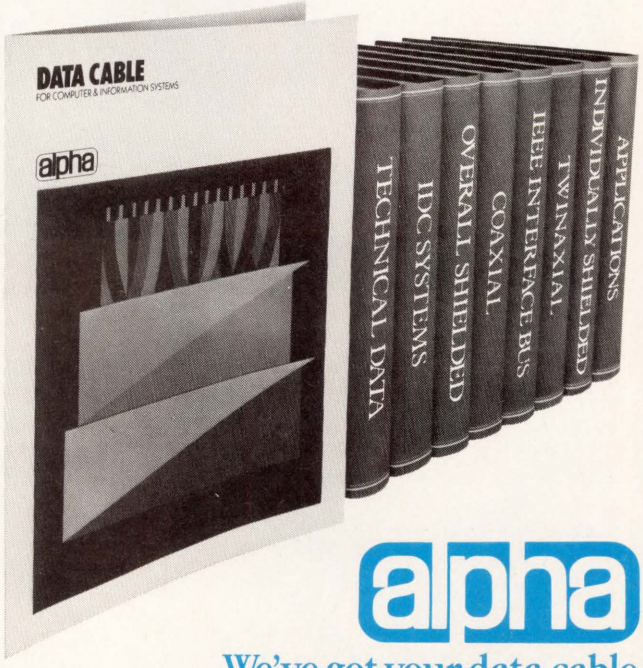
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CARTRIDGE TRANSPORT DISC BACKUP

Obvious choices do not guarantee effective tape cartridge backup. In some cases, an economical transport can be preferable to a high performance unit

by Darell Meyer

Originally developed as paper tape replacements, 0.25″ cartridge tape transports have evolved into sophisticated, relatively high capacity units that serve as ideal backup media for small system discs. Growth in the number of tape recording methods has accompanied this evolution, however, and techniques for recording tape cartridges differ markedly among transport manufacturers. Matching a cartridge transport to a small disc requires careful analysis of the characteristics of both devices and the manner in which they will be used. Relatively slow tape transports can prove to be the most economical choice and, in some cases, disc characteristics make it impossible to realize the full potential of a high performance tape unit.

About 11 manufacturers produce more than 30 different models of 0.25″ tape transports. In general, these transports accommodate 3M-type cartridges with 300′, 450′, or 600′ capacity. They have from 2 to 16 data tracks, and most use a data recording density that ranges from 6400 bits/in to 10,000 flux reversals/in. These parameters allow unformatted capacities ranging from 10M to 67M bytes/cartridge. (See Table 1.)

Darell Meyer is magnetic tape products marketing manager at Pertec Computer Corp, 21111 Erwin Street, Woodland Hills, CA 91367. Before this, he was tape product line manager with Kennedy Co, and a member of the technical staffs at Dataproducts Corp, Hughes Aircraft Co, Rockwell International Corp, and the Boeing Co. Mr Meyer holds a BSEE from the University of Wisconsin.

Recording techniques vary among tape units

Two basic recording modes are start/stop recording at 30″/s and streaming mode at from 30″ to 90″/s. Depending on tape speed and data density, transfer rates vary from 24k to 88k bytes/s. Some cartridge transports use a serpentine recording technique that eliminates rewind time. They record one track in the forward direction until the end of tape is reached, and then reverse to record the next track in the opposite direction. This process continues, alternating tracks and direction of motion, until the tape is filled.

Most cartridge transports have read after write heads, like those on conventional 0.5″ transports, for immediate verification that records were written correctly. In the event of an error during writing, the tape is stopped, reversed, and rewritten. A 67M-byte, 3M transport implements an alternative to this technique: It writes redundant data blocks with error correction frames and relies on sophisticated statistical methods to detect and correct any errors during subsequent read operations. This 3M unit also uses a tape cartridge with a preformatted track that locates records on the tape. Most other transports locate records by appending an identifier to the data.

TABLE 1

Representative Cartridge Tape Drive Parameters

	Kennedy 6450	DEI Funnel	DEI 7130 Streamer	3M HCD-75
Max capacity (bytes unformatted)	23M	17.3M	20M	67M
Max transfer rate (bytes/s)	24.0k	24.0k	29.3k or 87.9k	17.5k
Recording density (bits/in)	6400	6400	7500	10,000 flux reversals/in
Tape speed (in/s)	30	30	30 or 90	30
Number of tracks	4	4	2 or 4	16
Serpentine format	yes	no	yes	yes
Read after write	yes	yes	yes	no
Recording mode	start/stop	start/stop	streaming	streaming

At first glance, it appears that selecting the appropriate cartridge transport simply involves matching unformatted capacity and data transfer rate with the capacity and transfer rate of the disc unit. Unfortunately, it is not as easy as that. Designers instead must examine many other factors intrinsic both to individual data storage devices and to the storage system as a whole.

Useful capacity depends on recording technique

With start/stop transports, block size is paramount in determining formatted capacity. A fixed-length inter-record gap (IRG) follows each data block [Fig 1(a)]. Formatted capacity is the unformatted capacity multiplied by the ratio of block length to the sum of block length and IRG length. When blocks are large, IRGs reflect a small portion of total tape length; however, as blocks grow shorter the unrecorded portion of tape occupied by the IRGs grows larger proportionally. For example, a 450′ tape with 4 tracks recorded at 6400 bits/in has 17.3M bytes of unformatted capacity. Using 16k-byte blocks, formatted capacity is 16.3M bytes; however, capacity drops to only 11.7M bytes with 2k-byte blocks.

In streaming tape recording, controllers segment the data blocks they receive from the system into 480- to 512-byte segments, called blockettes, and append fixed-length strings of overhead bits or bytes that identify each blockette [Fig 1(b)]. Sometimes the term "transmission length" is used in place of "block size" to distinguish streaming from start/stop tape recording format. With streaming, the formatted capacity is simply a function of unformatted capacity and the ratio of message data to total formatted frame size. Thus, streaming tape formatted capacity does not depend on record or block size.

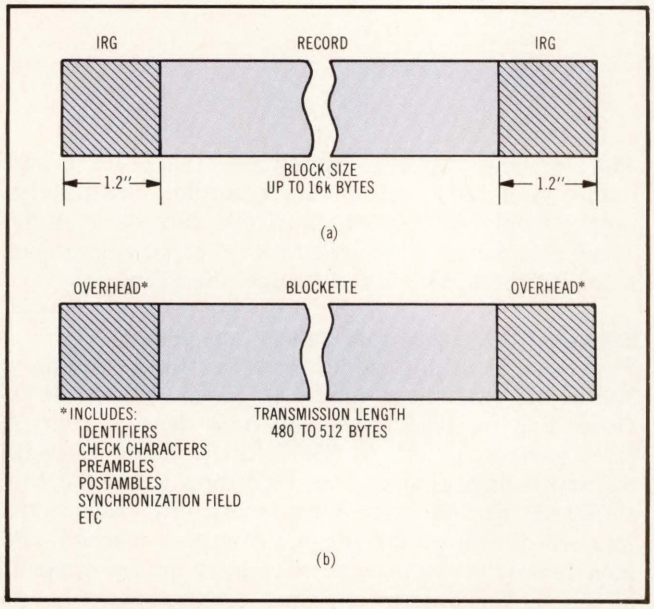


Fig 1 Cartridge tape recording methods. With start/stop recording, in (a), a fixed-length IRG follows each variable-length data block, making block size a critical parameter. Streaming tape recording, in (b), allocates data among fixed-size blockettes and has fixed-storage overhead

TABLE 2

Representative 8″ Disc Drive Parameters

Speed and Capacity		Min	Max
Unformatted storage (bytes)		3M	40M
TR_A	Data transfer rate (bytes/s)	500k	1200k
B	Bytes/track	10k	14k
U	Percent utilization	80%	90%
Access time			
	Max (full-stroke) access time	90 ms	150 ms
	Avg access time	40 ms	70 ms
T_A	Min (track to track) access time	8 ms	19 ms
Latency			
T_L	Max latency	17 ms	19 ms
	Avg latency	8 ms	10 ms

MIRROR MODE

$$TR_A = \frac{BU}{(T_A + T_L) + (T_L - T_A)}$$

$$= \frac{10{,}400\ (0.8)}{(19 + 19.2) + (19.2 - 19)}$$

= 216.7k BYTES/s

≈ 40% OF MAXIMUM TRANSFER RATE

FILE MANAGEMENT MODE

$$TR_A = \frac{BU}{2(T_{A1} + T_{L2} + T_L)}$$

$$= \frac{(10{,}400)\ (0.8)}{2(70 + 9.6 + 19.2)}$$

= 41.9k BYTES/s

≈ 8% OF MAXIMUM TRANSFER RATE

Fig 2 Disc transfer rate. Even in relatively efficient mirror image mode, disc properties reduce actual transfer rate to only 40% of theoretical rate. In more practical, file management mode, transfer rate is less than 10% of theoretical specification. Parameters are for Shugart SA1000 disc drive

Disc characteristics reduce transfer rate

Dozens of 8″ Winchester disc drives are on the market; many others are now being evaluated or developed. Their unformatted capacities range from 3M to 40M bytes, and data transfer rates vary from 500k to 1.8M bytes/s. (See Table 2.) Unformatted capacities for disc and tape are not the same. With disc, each sector has headers, synchronization bytes, and error correcting bytes that impose a certain amount of fixed overhead. Typical disc recording efficiency is about 80%; however, 90% or higher utilization can be achieved with careful resource management.

Disc data transfer rates seem fast when compared to tape transfer rates, but disc-to-tape transfer is not as straightforward as simply matching transfer rates. Disc access time and latency both slow the actual data transfer rate dramatically. Maximum full-stroke access time is the time required for the read/write head to traverse a disc from first track to last track. It ranges from 90 to 150 ms. The minimum track-to-track access time of 8 to 19 ms is needed for the head to move between adjacent tracks. Average access time, the time required to move across one-third of the available tracks, varies from 40 to 70 ms. Maximum latency time, or the time required for the disc to make one revolution under the head, is 17 to 19 ms; average latency is one-half of the maximum amount.

Transfer mode is a final consideration

To see the effect of access time and latency on data transfer rate, it is important to understand the different motives for moving data from disc to tape and the different transfer modes that achieve these goals. During a *mirror image* transfer, which is intended primarily for straightforward backup operations that guard against disc malfunction, data are copied sequentially, sector by sector and track by adjacent track. Since the head always moves from one track to an adjacent track, only one seek is needed, and access time is only about 19 ms. Latency can exceed track-to-track access time, however, in which case the head just misses the index mark by the time it is positioned over a track. In this instance, the disc must make nearly another complete revolution before it can start to read data, and transfer proceeds at an average rate of less than half of the theoretical maximum rate.

Although mirror image backup provides a means of preserving files and protects against catastrophic disc failure, it is not very efficient from the standpoint of resource management. Data processing managers want to protect disc data, but they usually perform some kind of manipulation when they move data onto tape. They often consolidate data stored on widely separated disc tracks into one tape region. Typical examples include inventory items, orders, and payroll information. In addition, managers may want to compile obsolete files and move them onto tape to make room for more active data.

NUMBER OF BLOCKS WRITTEN

$$N = \frac{C}{R}$$

WHERE:

N = NUMBER OF BLOCKS WRITTEN
C = DISC CAPACITY TO BE DUMPED (M BYTES)
R = RECORD SIZE (M BYTES)

DUMP TIME

$$T = \frac{N}{60}\left[T_I + \frac{8R}{SD}\right] + T_{RW}$$

WHERE:

T = DUMP TIME (min)
N = NUMBER OF BLOCKS WRITTEN
T_I = INTERRECORD BLOCK TIME (s)
S = TRANSPORT SPEED (in/s)
R = RECORD SIZE (BYTES)
D = RECORDING DENSITY (BITS/in)
T_{RW} = REWIND TIME (min)

SYSTEM PARAMETERS

DISC CAPACITY	10M BYTES
RECORD SIZE	4k BYTES

SAMPLE CALCULATION

NUMBER OF RECORDS:

$$N = \frac{10}{0.004} = 2500$$

DUMP TIME FOR 10M BYTES:

$$T = \frac{2500}{60}\left[0.06 + \frac{(8)\ (4096)}{(30)\ (6400)}\right] = 9.6 \text{ min}$$

Fig 3 Dump time for start/stop recording. Dump time is proportional to number of blocks, but rewind time and media exchange time perhaps must be added. Parameters are for Kennedy 6450 in Table 1

Two seeks are needed to transfer a record from disc to tape in the so-called *file management* mode. The read head first moves to a disc track containing address sectors, then reads the address for the designated data track, and finally moves to this track where it can read sector data. It is unlikely that the head will be positioned precisely over the index mark when it reaches either track; instead, the disc must rotate through half a revolution, on the average, until the index mark passes under the head. Since addresses and data can occupy any sector, the disc next makes a complete revolution to read information. The cumulative result of these head and disc motions reduces average disc data transfer rates to less than 10% of the theoretical maximum. (See Fig 2.) Interleaving, which requires another disc revolution for each access, further reduces the transfer rate.

Analysis must compare apples to apples

Surveys indicate that data processing managers prefer to spend only about 15 minutes transferring data from disc to tape, although 30 minutes is marginally acceptable. Disc-to-tape transfers that take longer than 30 minutes reduce the frequency of maintenance operations, the availability of system resources, or both. In addition, there is strong resistance to making more than three media changes. Excessive media changes indicate greater need for expensive offline storage space and increased risk of operator error. Calculating disc-to-tape dump time can formalize these constraints.

With start/stop recording, total time required to store data from disc is directly proportional to the number of data blocks and to the sum of IRG time plus data block recording time. Unless a serpentine recording format is used, rewind time must be added. Also, if disc capacity exceeds tape capacity, dump time calculations must allow for media exchange. By convention, each cartridge replacement adds one minute to dump time. Fig 3 gives sample calculations for a typical, 30″/s, start/stop, serpentine transport storing 10M bytes from disc in 4k-byte blocks. With a 4k record and buffer size, dump time is 9.6 minutes. A 64k-byte record, fully buffered, requires only 7.1 minutes. For the same recording conditions, non-serpentine transports at 30″/s give 11.6- and 9.1-minute dump times, respectively.

Streaming tape transports present a slightly different situation, although the calculations are similar. As long as data remain available, these devices operate continuously. When data are interpreted they then stop and back up to a point from which they can accelerate to operating speed when data arrive for the next transfer. (See Fig 4.) Repositioning time is significant, especially at high tape speeds. A 30″/s machine needs 400 ms to reposition and ramp up to speed; a 90″/s streamer takes a full 1.2 s to perform the same function.

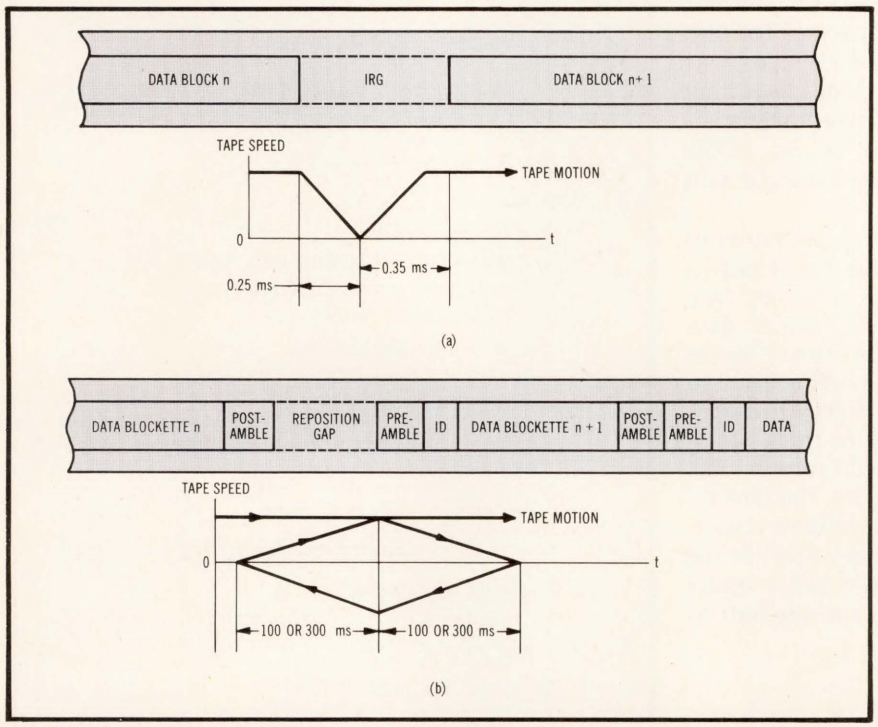
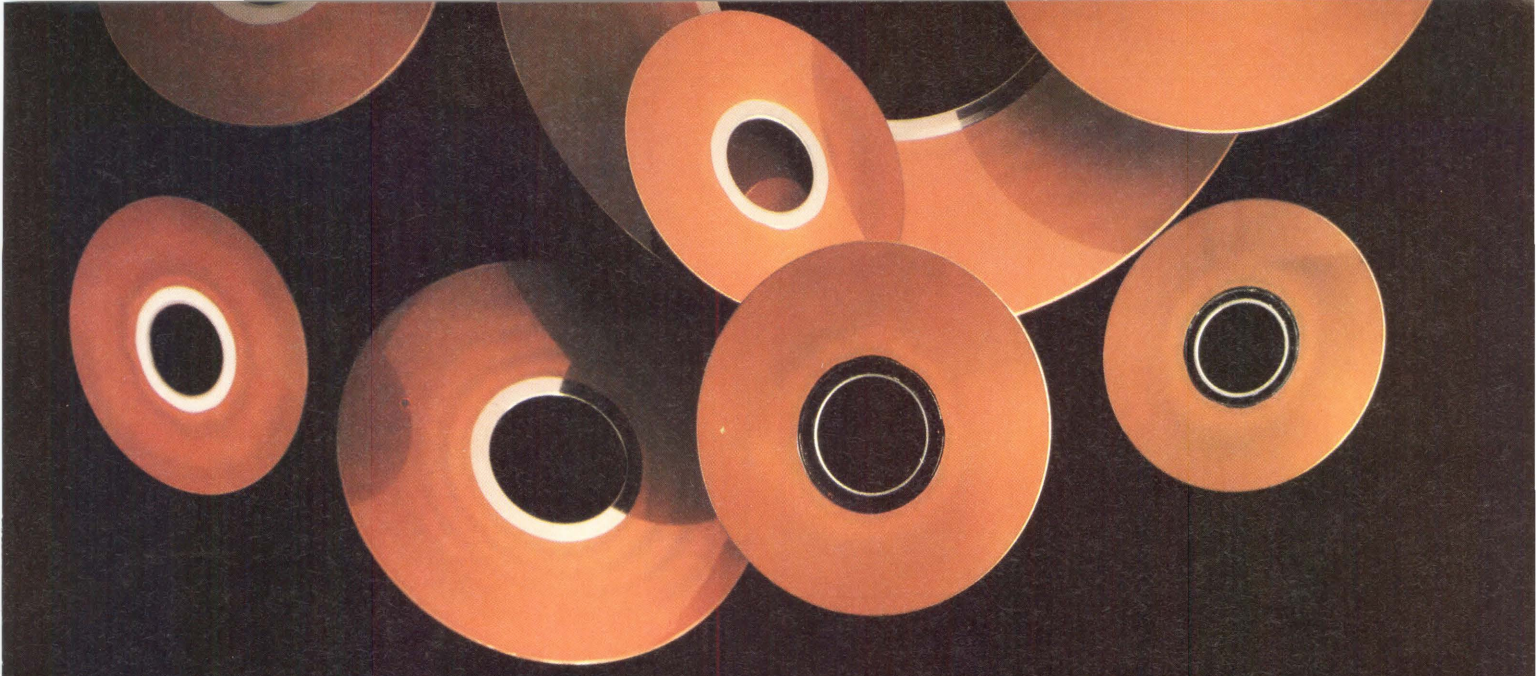


Fig 4 Tape motion. Start/stop recording method (a) ramps tape to a halt within IRG and later ramps tape up to speed to write next block. Streaming tape drive (b) must stop, reverse direction, back up, and return to speed within repositioning gap

One or more buffers can reduce the need to reposition. At 90″/s, for example, a streaming tape drive accepts nearly 88k bytes/s, whereas the disc supplies only 42k bytes/s during a file management transfer. Since streamers partition data into fixed-size blockettes, there is no absolute correlation between record size and buffer size. One large buffer can be used; when it is empty, tape repositioning can then be allowed. Alternately, a ring of smaller buffers can be used, with several buffers being written to tape while one is filled from disc. Whatever the buffering scheme, streaming tape dump time depends mainly on the number of times tape is repositioned and, therefore, on the size of the buffer. (See Fig 5.)

Time needed to store data on a streaming tape is the sum of total repositioning time and the time to stream without stopping. As before, unless a serpentine transport is used,



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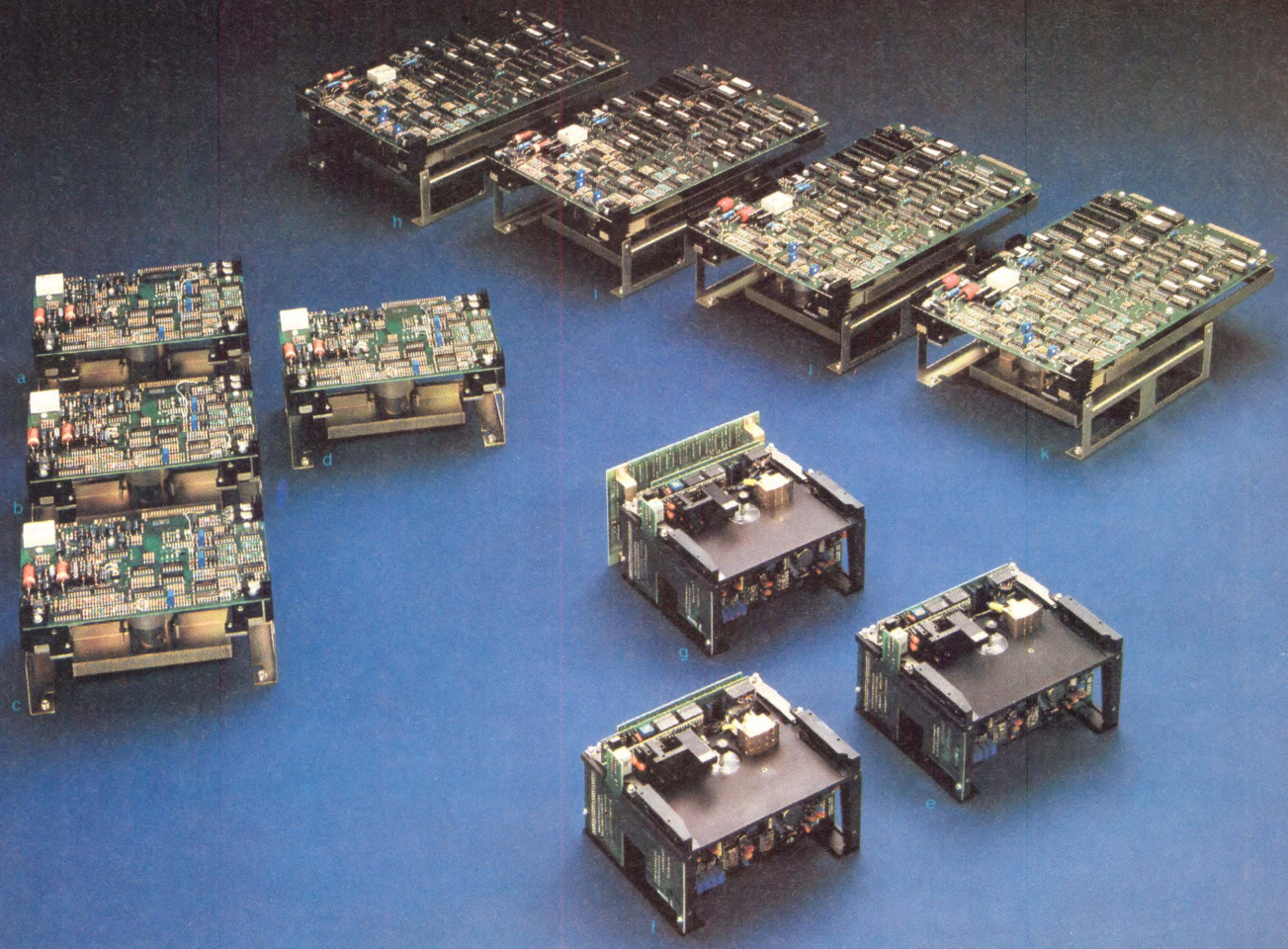
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d. 20 Mbytes/90 ips	g. Codec electronics	k. 20 Mbytes/90 ips



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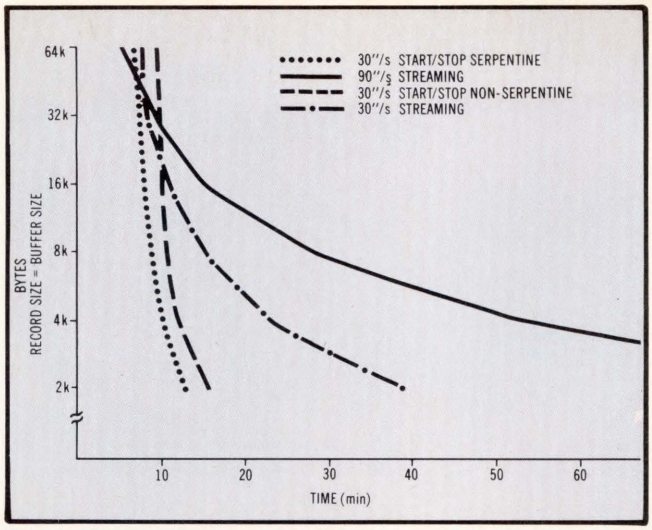


Fig 5 Dump time vs record size. Graph plots time to dump 10M bytes from disc to tape using one single-record buffer and file management transfer mode. Rewind time makes non-serpentine unit slower than serpentine unit, and repositioning time makes streaming unit slower than start/stop unit

rewind time for each track must be included. Sample calculations for a typical system appear in Fig 6. In order to compare apples with apples, the transport operates at only 30″/s and has a buffer size selected to match the data block size used in the start/stop mode computations of Fig 3. A 30″/s streaming cartridge has a dump time of 22.7 minutes for 10M bytes with a 4k buffer. At 90″/s, dump time is 52.2 minutes.

With the shorter records normally found on small business machines, excessive tape repositioning increases dump time dramatically. A 64k-byte buffer brings the dump time down to a more respectable 7 minutes for 30″/s recording, or 5.1 minutes at 90″/s. However, the economics of putting a memory this size into a small system require careful analysis. Instead, a start/stop transport might provide a more effective compromise between dump time and total system cost.

Final choice reflects many options

Selecting the proper cartridge tape transport to back up a Winchester disc involves more than checking data sheet specifications. The final choice requires detailed knowledge of the system and how it will be used. In some cases, mirror image backup may be the only requirement, while in other cases some file management or data manipulation may take precedence. Characteristics of both the tape cartridge transport and the disc drive must be examined. Small, 8″ and 5¼″ drives are relatively slow devices, compared to larger 14″ Winchesters or removable media units. Apart from size, access time and latency further reduce actual transfer speed. Tape transport recording modes and associated buffering requirements also need careful consideration. Although semiconductor memory is becoming less expensive, in the final analysis it may be worthwhile to avoid the cost of a large buffer by using start/stop recording techniques.

NUMBER OF REPOSITIONS/CARTRIDGE

$$N_R = \frac{C}{B}$$

WHERE:

N_R = NUMBER OF REPOSITIONS
C = DISC CAPACITY TO BE DUMPED (M BYTES)
B = BUFFER SIZE (M BYTES)

DUMP TIME

$$T = \frac{N_R T_R + T_S}{60} + T_{RW}$$

WHERE:

T = DUMP TIME (min)
N_R = NUMBER OF REPOSITIONS
T_R = REPOSITION TIME (s)
T_S = NONSTOP STREAMING TIME (s)
T_{RW} = REWIND TIME (min)

NONSTOP STREAMING TIME

$$T_S = \frac{12L\ tr}{S}$$

WHERE:

T_S = STREAMING TIME (s)
L = TAPE LENGTH (ft)
tr = NUMBER OF TRACKS
S = TRANSPORT SPEED (in/s)

SYSTEM PARAMETERS

DISC CAPACITY	10M BYTES
BUFFER SIZE	4k BYTES

SAMPLE CALCULATION

NUMBER OF REPOSITIONS:

$$N_R = \frac{10}{0.004} = 2500$$

DUMP TIME FOR 10M BYTES:

$$T = \frac{2500\ (0.4) + \frac{450(12)\ (2)}{30}}{60} = 22.7 \text{ min}$$

Fig 6 Dump time for streaming tape recording. Sample computation uses system design constraints similar to those of start/stop example in Fig 3. Parameters are for DEI 7130 in Table 1

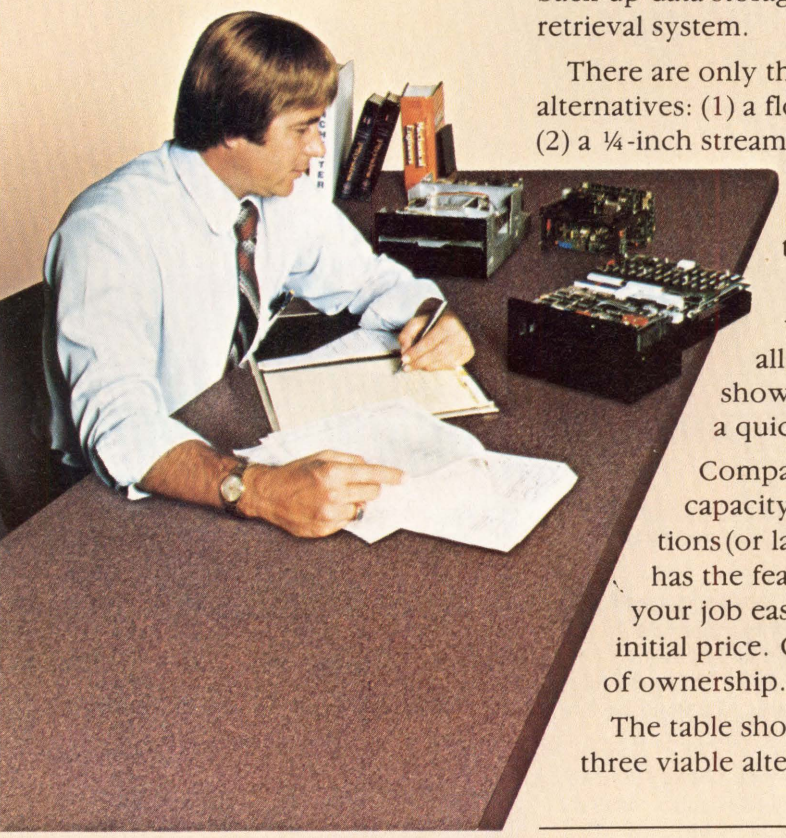
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Device	Formatted Capacity (MB)	Cost/MB (Qty. 500)	Number of Media Required	Total Media Cost	Recording Time (Min.)	Operator Involvement
8" Floppy Disk DS/DD	1.3	$400	16	$80	34	Multiple media insertions
Archive ¼" Streaming Cartridge Tape	20.0	$31	1	$30	4 (90 IPS) 12 (30 IPS)	One media insertion
¼" Start/Stop Cartridge Tape	8.6	$140	3	$90	60 (30 IPS)	Multiple media insertions



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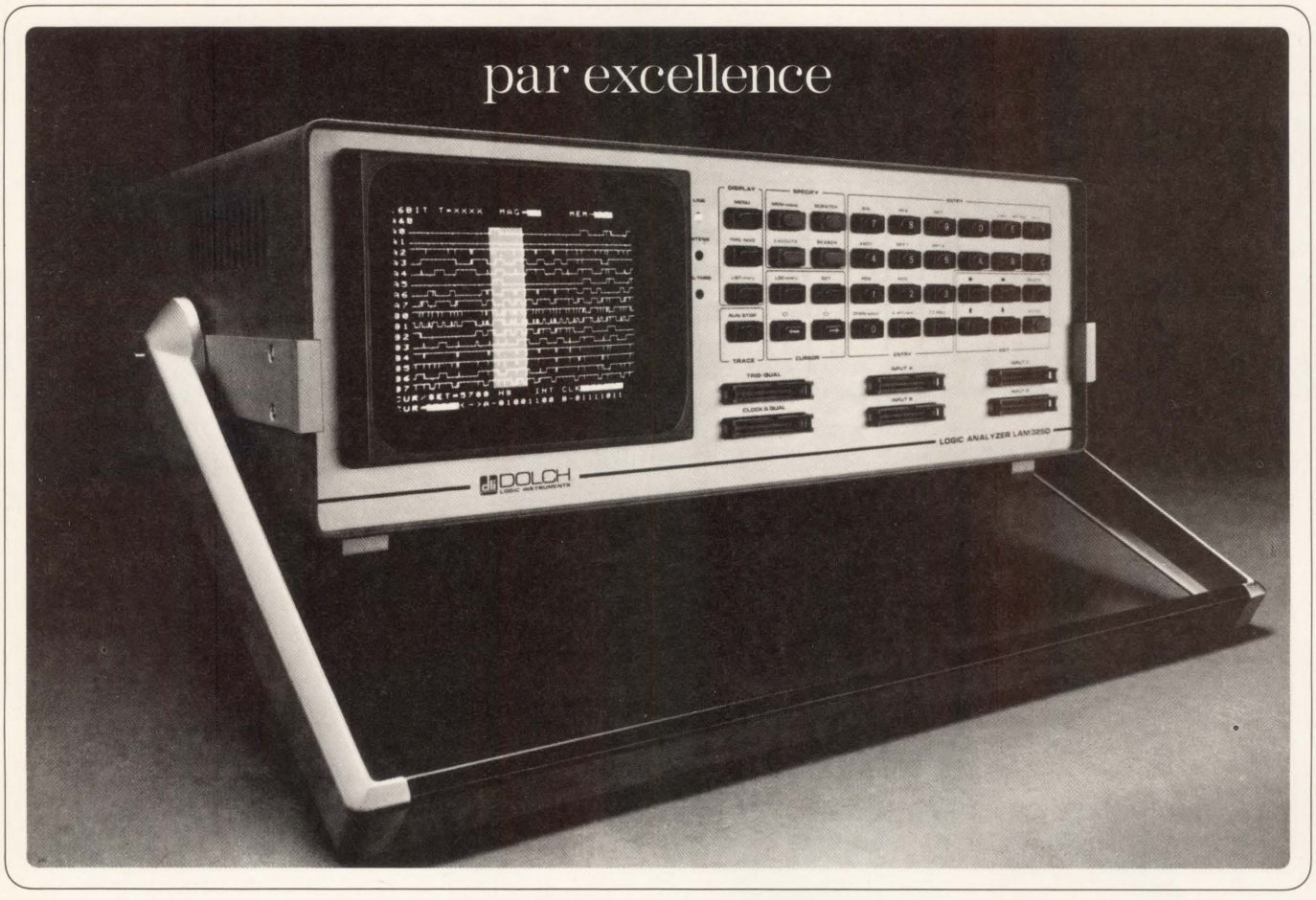
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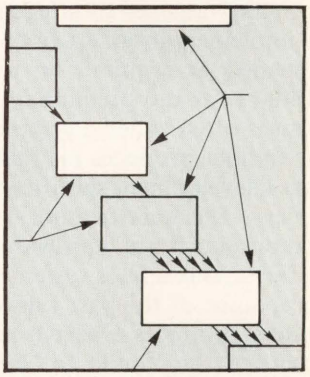
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PROJECT MANAGEMENT SKIRTS SOFTWARE PITFALLS

Turnkey system development method combines engineering and management expertise to reduce schedule delays and cost overruns

Craig Shermer
Michael A. Neighbors
Robert Maitland

Success in developing software for turnkey data processing systems requires close coordination between the user and the builder. To guarantee that project requirements are satisfied, information must be transmitted in documents identified in a contract. These documents state the builder's position with respect to the user's requirements and define the responsibilities of both parties through the system specification and statement of work. Some of the builder's documents detail contractual specifications; others describe interface definition, testing, reliability, special studies, and specification changes. Each document represents an assertion by the builder that he has satisfied a statement of work requirement, the truth of which remains for the user to determine. In any event, timely and close communication is important during software development, for the complexity of software requirements almost guarantees that unresolved problems will escalate costs and overrun schedules. Comparisons of medium to large systems show that finding errors before implementation can ultimately reduce costs by ten to one, or even more (Fig 1).



System specifications

The system specification produced by the user and incorporated into the request for a proposal is the user's definition of the functional and performance requirements. It is a baseline that gives the builder a goal against which to propose specific software. Builder response, when fully accepted by the user, represents an allocated baseline. This is the first potential area of

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Robert Maitland, also with Associated Technology Co, is an independent consultant in system engineering, configuration management, and project management. He has a BS in physics from Pennsylvania State University and a BS in electrical engineering from the University of Miami.

As project manager for the Directorate of Engineering Development, Arnold Engineering Development Center, Arnold Air Force Station, TN 37389, Craig Shermer is currently responsible for the development of the Center's MX-Missile data acquisition and control system. He received his education at Oklahoma State University, the University of Tennessee, and the American Graduate University.

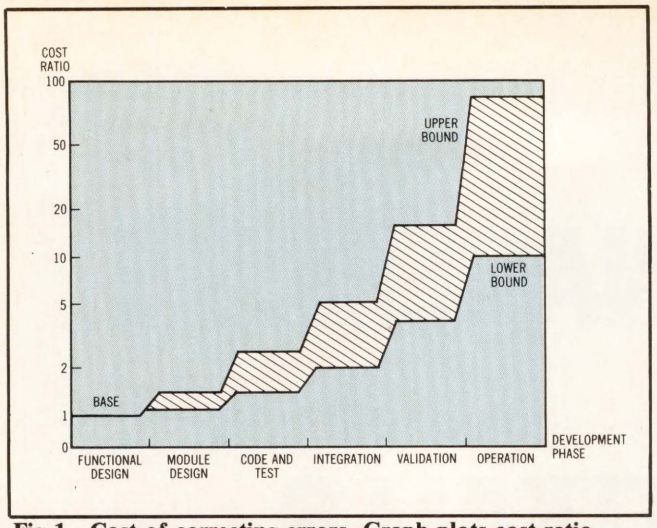


Fig 1 Cost of correcting errors. Graph plots cost ratio (actual cost divided by cost at functional design phase) for correcting errors at various stages in software development cycle, based on data from major developers

misunderstanding for two reasons: the allocated baseline often contains less than 5% of the detail required in the final design; and many specifications, while operationally clear to the user, lack sufficient information for the builder. To bridge this communication gap, timely, in-depth reviews of the builder's progress are necessary.

At least three progressively detailed design reviews are normally required to safeguard the design and to ensure its implementation. At first, the baseline is corrected or amended as required on the basis of the knowledge available at the preliminary stage of design (Fig 2) in what is often called a system requirement review. Next, the builder produces his first expanded design, called a part I development specification, in a preliminary design review. This specification describes inputs, processing, and outputs for all hardware and software; identifies interfaces; and refines system capabilities. Following user acceptance of the part I development specification, the builder produces a part II product specification, which describes the "build to" requirements. For hardware systems, this includes dimensional part layouts and wiring diagrams; for software, flowcharts required to produce code. This last level of design is formally documented and reviewed at a critical design review.

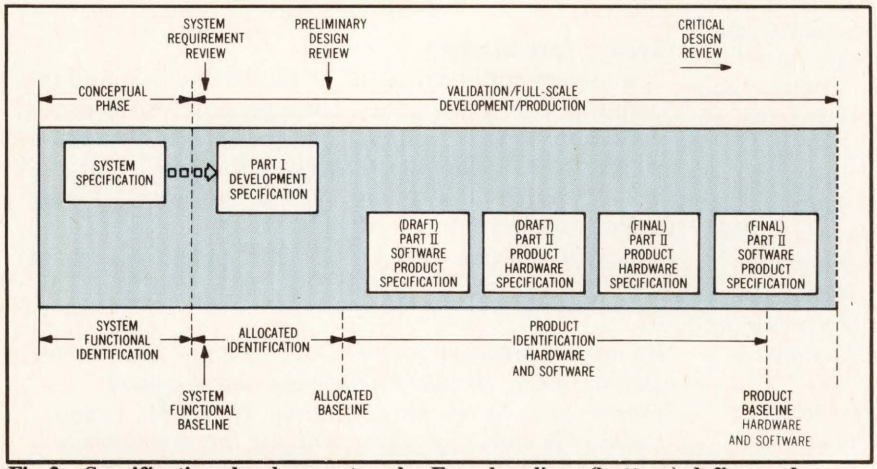


Fig 2 Specification development cycle. Four baselines (bottom) define and control stages of specification as system evolves through part I development specification to final part II product specification (middle). Three progressively detailed design reviews (top) ensure proper implementation

The aforementioned baselines define and control the configuration, arrangement, and application of all system elements for contractual purposes. Specifications form a major part of technical contracts and are structured so that the requirements are well defined, but not in such detail as to preclude flexibility in design implementation. Each baseline should be carefully generated from and traceable to the design requirements derived from the preceding level of documentation. The data defining the system characteristics may take any form, including physical and mathematical models, schematics, layouts, detailed drawings, and engineering graphics. Finally, the deliverable "configuration items" are generated according to the "configuration management" program requirements of the contract.

In addition to formal document submissions, there must be a continuous flow of information. Informal discussions for clarification may take place at any time. Changes or clarifications that impact the baseline configuration must be reviewed formally and be issued as authorized directives. Items that change the baseline configuration consist of proposed configuration changes and requests for temporary deviations and waivers to allow work to proceed in the event of unforeseen difficulty. For each configuration change, an engineering change proposal establishes the work involved. When implemented, this proposal becomes part of the new baseline configuration. Fig 3 shows a typical configuration change procedure for engineering change proposals and temporary deviations or waivers. In both procedures, the builder and user must be represented at several levels.

Throughout the project, the traceability of requirements is essential. "Traceability" here refers to the process of tracking requirements in both directions between their origin and the equipment and/or software that fulfills those requirements. To keep this process from becoming an overwhelming task, records of traceability are usually maintained only from one contractual base to another. For example, traceability during design definition is limited to requirements contained in baseline specifications. Each specification requirement is then traceable to its origin, ie, the systems specification, statement of work, functional analysis, synthesis, trade study, or requirements allocation. Requirements no longer need to be tracked once the specifications have been approved by the user, since approval establishes a new requirements baseline. However, all documents needed to show traceability from the requirements to the approved specification should be retained for historical purposes. Traceability between functions and equipment is also required to ensure that each function identified by the functional analysis has been implemented, and to show what functions are performed by various system elements.

Technical reviews and audits

During software development, technical reviews and audits help to

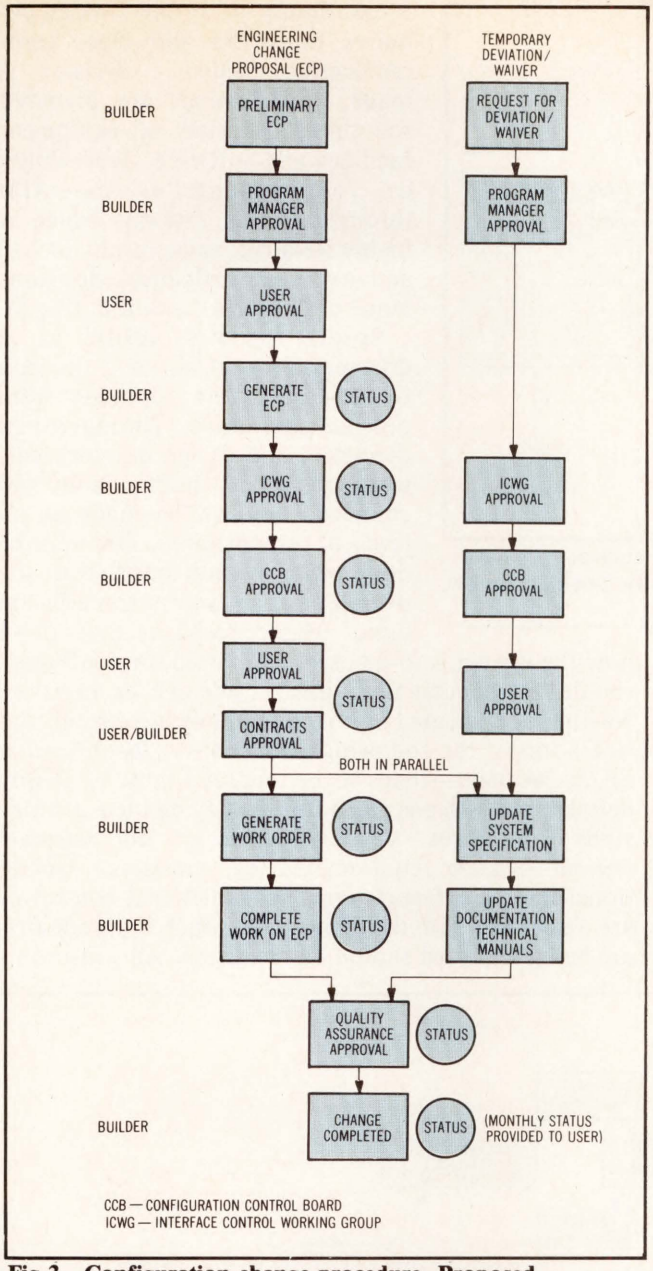


Fig 3 Configuration change procedure. Proposed configuration changes must be reviewed formally and issued as directives; however, temporary changes can allow work to proceed despite unforeseen difficulties

reduce conflicts between the user and builder when they are determining requirements. Discovery, exposure, compromise, and consensus are involved in establishing requirements, and resolving conflicts early can minimize expensive problems later. Technical reviews and audits as defined in the contract statement of work provide formal procedures for arriving at baseline configurations. Fig 4 identifies important reviews and audits and shows approximate dates for a typical 18- to 30-month contract. The system requirement review, the first in the series, usually takes place 30 days after contract award, and is followed by monthly meetings throughout the contract to discuss newly identified problems. Between 75 and 100 days after contract award, the compliance of development specifications with hardware and software requirements is examined at a preliminary design review. These meetings may take place over several weeks to cover all configuration items. After approval, the design proceeds to "build" level specifications. Between 150 and 200 days after contract award, a critical design review, which may be held in parts over several weeks or months, identifies products.

Subsequent reviews establish that assembled hardware and software perform as documented. They consist of a physical configuration audit held at the builder site before shipment and an extensive formal qualification review of equipment installed at the user site. The latter can be largely satisfied by category I and category II testing discussed in the next section.

A helpful tool for the user in the review process is a requirements matrix, or capability matrix, which can serve as a computer data base for tracking requirements as they develop into designs. The data base can easily cross-refer requirements involving interactions, track test plans, flag action items, generate schedules, and provide timely reports for technical and cost audits. With only a modest database management facility, it can readily identify trouble spots that appear as requirements are traced through their development. (See Fig 5.) In most cases, this data base is tailored to the specific program documentation.

A data base for requirements tracing is quite effective in technical audits for software development. Software is often procured at a higher risk than hardware since it usually calls for new designs. But, regardless of the emphasis given to software, audits and reviews deserve considerable attention and should be staffed far enough in advance by the user to ensure success.

As for equipment supplied by the user, a continuous assessment of interfacing elements is necessary if the system is to develop as a system rather than as a collection of unrelated items. The engineering technique to ensure this is provided by the capability analyses performed during all phases of the program and at all levels of the design process.

It must be shown that the requirements preceding each baseline, such as those of time, funding, and state of the art, are consistent with the program's objectives and feasibility. Furthermore, the derived requirements must be mutually compatible. In the final phases of the program, the hardware elements must be physically and functionally compatible, and their performance capability compatible with the design requirements. Likewise, all the intervening baselines must subject all programmatic, functional, physical, and performance interfaces to iterative analysis if harmonious system operation is to be realized.

A minimal sequence of steps for this process should include the following: (1) a definitive statement of the interfacing elements, (2) a statement of the functional, performance design, or other requirements attendant upon each of the interfaces, (3) a comparison of the requirements of each element with the capability of all other elements with which it interfaces, and (4) a listing of all potential incompatibilities identified along with a description of each incompatibility. The importance of technical reviews and audits cannot be over stated, for the quality and quantity of information exchanged between the user and builder at these meetings will determine whether or not the user gets the system he really wants.

Testing

Testing is vital to the design of computer based systems. Because the software will be no better than the test plan

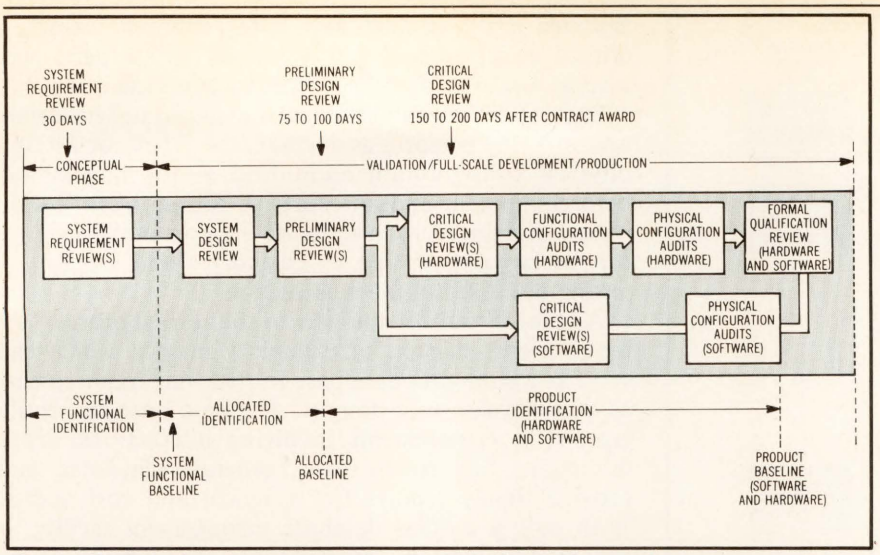


Fig 4 Technical reviews and audits. Typical 18- to 30- month contract provides formal procedures for arriving at baseline configurations. Ideally, two-part review separates software from hardware

under which it is accepted, initial test requirements should be given to the builder as part of the system specification. Throughout the project, the builder should expand test plans to support his own needs in building the system (category I) and to fulfill requirements detailed in the system specification (category II). The user should give high priority to a review of these plans. In the development phase, category I tests are configured to support intermediate test requirements, which are part of the "build" function. Similarly, category II tests are configured to demonstrate compliance with the system specification. Test planning is a responsibility shared by the user and builder. Test plans will be simple if the software is modular, but they can be virtually impossible if the software is not modular.

Special studies

As a part of the general engineering process, requirements are defined, expanded by functional analysis, and allocated to subelements of the system. Systems are synthesized from subelements, defined, and implemented. Compatibility analyses are conducted to ensure that subelements are compatible with each other, the system, and the requirements. Trade studies and design optimization and effectiveness analyses are usually conducted at this point to resolve incompatibilities and to optimize the system. Those studies may be performed to determine maintenance, storage spaces, repair levels required for the system subelements, producibility of subelements, reliability, facility data, algorithms, failure mode analysis, error detection, and configuration testing. In each case, the user and builder share the responsibility of review, which requires timeliness and close communication. When a decision is made, specifications are prepared for the acquisition of equipment facilities and software. Traceability of requirements is essential throughout this process, which is highly iterative, since results of one activity can influence decisions made during other activities (Fig 6).

Special studies result in a documented analysis of a decision to select the best approach from possible alternatives. During system definition and design development, many decisions, both simple and complex, need to be made at all levels of responsibility. This must be done on a rational basis, with the overall program and system effect in mind. Major decisions that affect how the system is to be used, supported, or configured should be documented. Each trade-off or decision, whether documented or not, should involve careful consideration of the following elements: (1) *Identification of the problem*—Items to be analyzed must be clearly defined, and reasons given for identifying them as trade study candidates. (2) *Definition of the selection criteria*—System requirements (eg, functional, operational design, support, cost, schedule) that control or are associated with the activity for which the trade-offs are being analyzed should be identified. All constraints

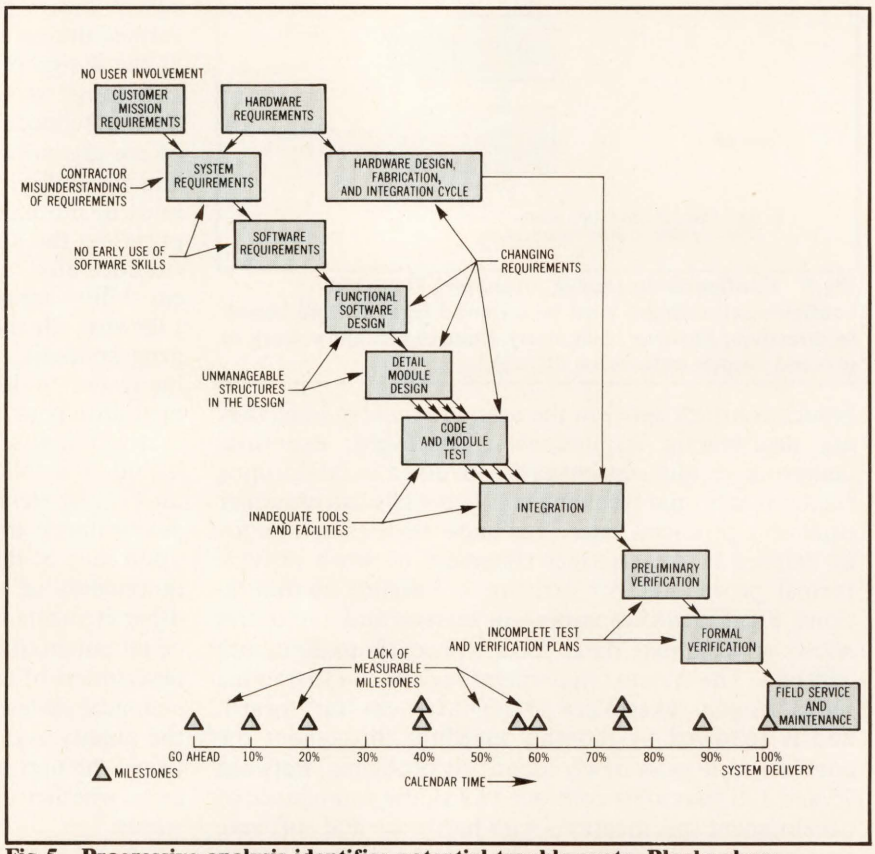
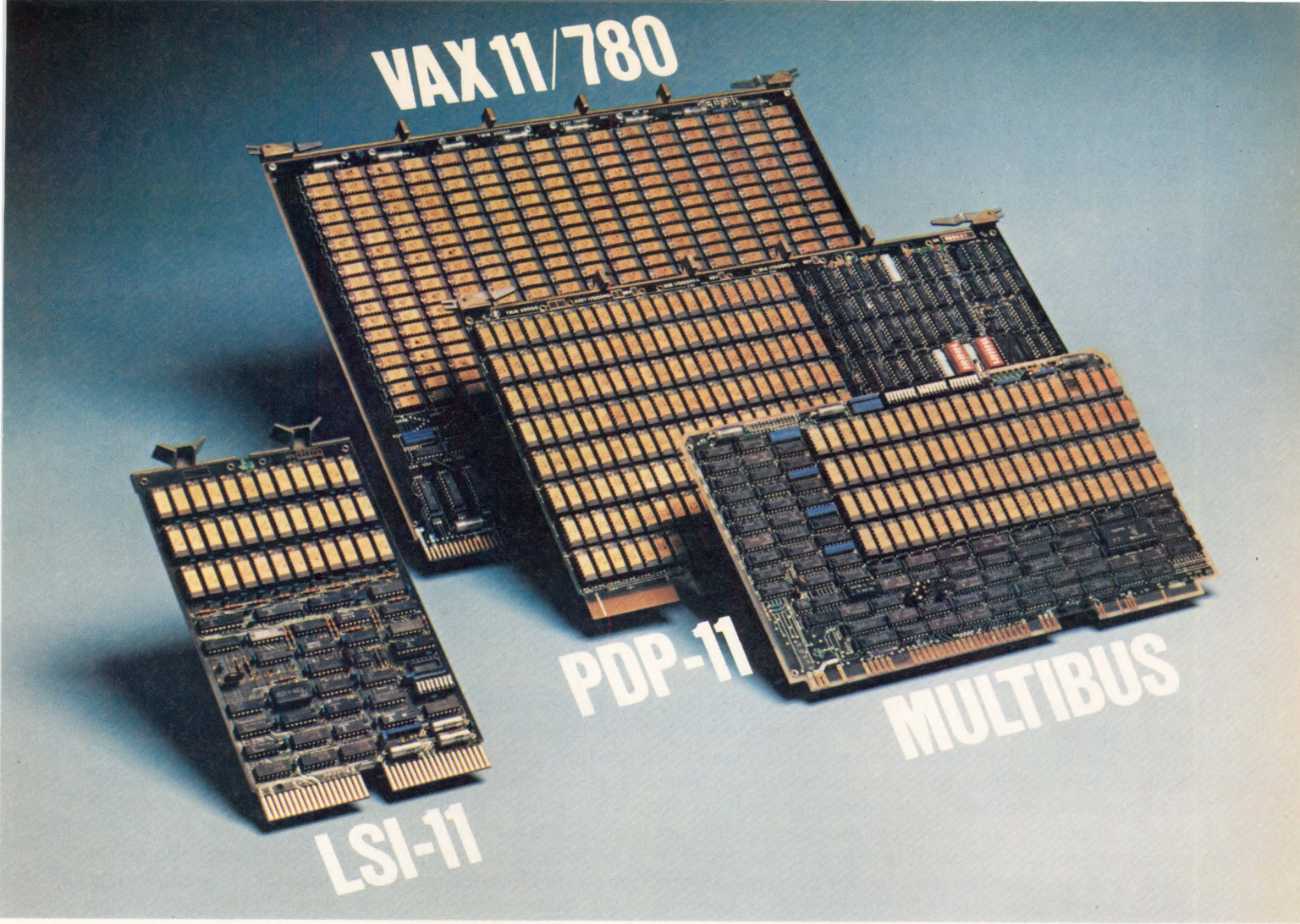


Fig 5 Progressive analysis identifies potential trouble spots. Blocks show successive stages of development cycle plotted at bottom. Labels show possible problems that can impact each stage of development. Straightfoward analysis of software requirements can reveal these difficulties



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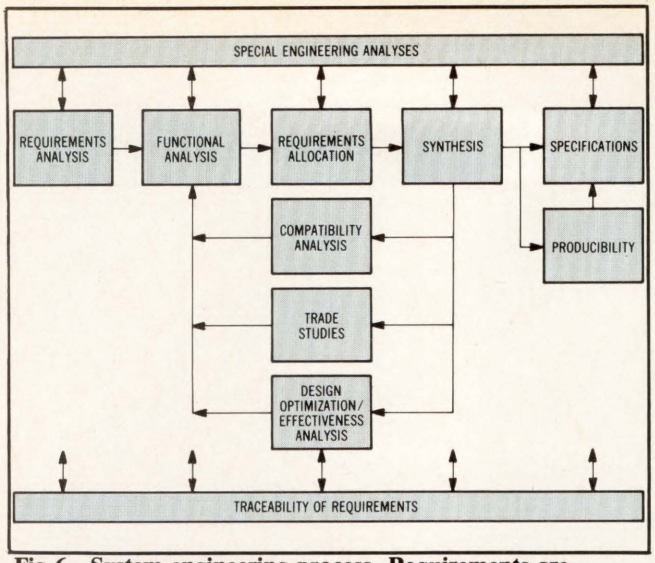


Fig 6 System engineering process. Requirements are defined, expanded through analysis, and allocated to system elements. Compatibility analyses, trade studies, and optimization resolve incompatibilities. Results of any one activity influence others, and all activities affect final specification

that are imposed on the activity under study, including definition of the weighting factors, should also be identified. (3) *Definition of possible alternatives*—The significant characteristics of each approach should be identified. Each alternative should be evaluated in terms of its ability to conform to the identified requirements and constraints. (4) *Evaluation of approaches*—The approaches should be compared to determine the degree to which each one satisfies the functional, technical, and contractual requirements. Also, the identification of the problem and selection criteria must be reexamined, in light of the evaluation, to verify applicability. (5) *Selection of the preferred approach*—A sound rationale for selecting an approach should be found by using the selection criteria just defined. When considering alternatives, attention must be paid to system/cost effectiveness with a view to achieving the best product/dollar ratio. Analyses of system cost, including life cycle cost, should be an element of each trade study and be weighted accordingly.

Transition to operational use

The user must play an active role in the transition to operational use. Since turnkey systems are customized, unique engineering problems should be anticipated. These may be software errors not detected prior to acceptance, the planning of spares for maintenance, or modifications to improve operation. Test personnel must be trained, and documentation must be corrected so that it parallels "final" system changes. Ideally, the transition is accompanied by a refinement of the initial software maintenance plan.

Staffing a system engineering management team

A system engineering management team can maintain control of large software procurements and ensure that the requirements of the user's system specification are met. The team's chief responsibilities are to track the configuration by reviewing contractor documentation, to participate in design reviews and system tests, and to assist in the transition to operational use. The user's system engineering management should apply to all major subsystem and facility interfaces. A staff of system engineers, supported by data entry personnel, can maintain the level of engineering management required for most procurements. A logical division of activities should minimize staff size. Since little time is available for new personnel to learn the system requirements, senior level engineers need to be assigned prior to contract award.

As already mentioned, errors detected early in the development cycle can result in major cost savings. The user is responsible for specifying technical and operational requirements. In contrast, the system engineering team provides project control by ensuring compliance through data management, configuration control, and requirements tracing. In view of the large requirements base normally to be tracked, computer database tools are helpful in controlling cost, schedules, and requirements. When thousands of individual requirements are to be traced, a careful division of effort is necessary between technical requirements and systems engineering management. For medium to large software procurements to be a success, they must be simultaneously successful with respect to technical requirements, cost, and schedules.

Summary and recommendations

Experience with turnkey system development has shown that close coordination between the user and builder is essential. Delays by the user in fulfilling responsibilities will produce schedule slips and result in a vicious circle of negotiated cost increases by the builder.

The history of medium to large software development projects indicates that everything that was done right was done early. Being a paper business, software demands structure. The tools and knowledge to manage software exist today, and system engineering management offers one structure for using this knowledge. The complexity of requirements, coupled with tight schedules, normally calls for an effective system engineering management effort by the user. Most important will be the caliber of the personnel, for effective management requires individuals with expertise in system engineering as well as the design disciplines involved. To ensure a successful procurement, the user should have a system engineering management team ready no later than contract award day. A highly success oriented schedule would have the team assembled prior to request for proposals.

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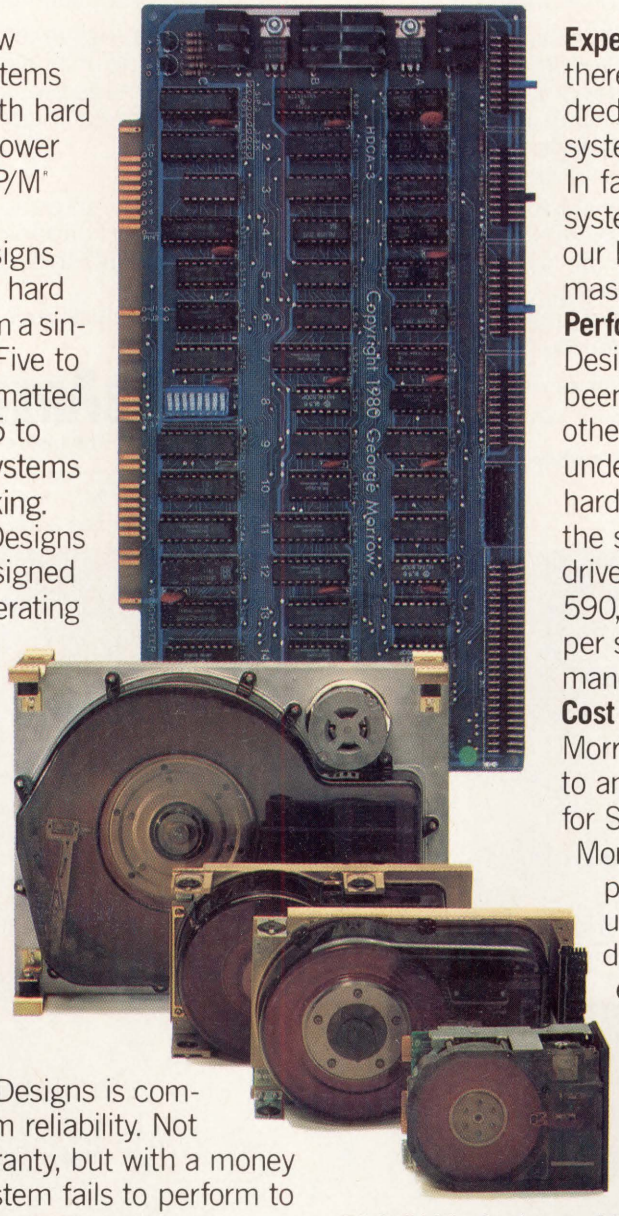
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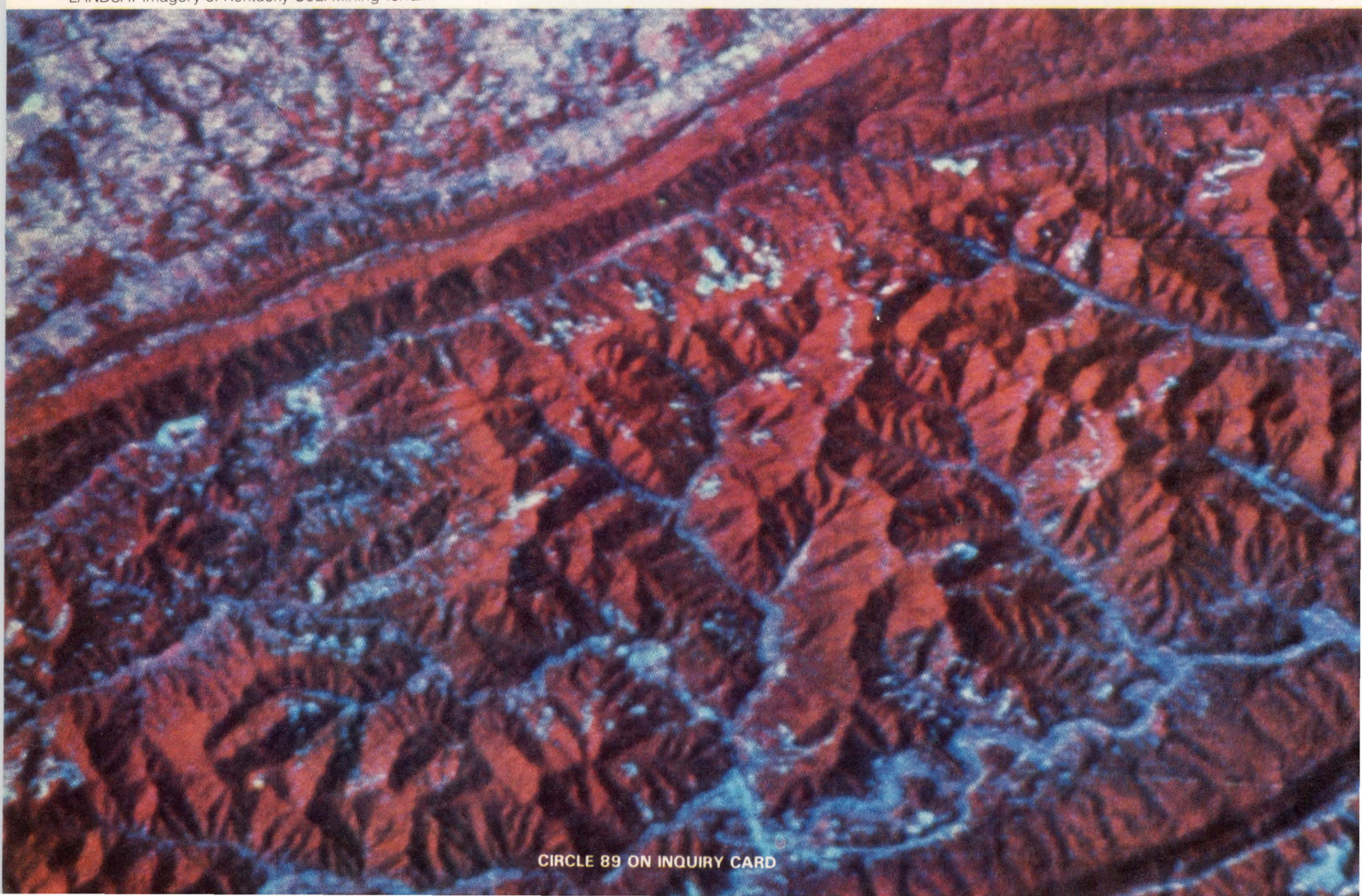
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COMPUTER GRADE PERIPHERAL ACTUATORS

Determining specifications is only the first step in choosing a computer grade solenoid

by David Luckenbach

Solenoids may appear to be easy to specify because of their simple design. In general, however, the many electrical and mechanical considerations involved in specifying a solenoid for a particular application make the selection more complex than it might seem. This is true especially in the case of computer grade solenoids. Designers must ensure that these solenoids offer long life to perform millions of operations and that they sustain accurate timing throughout their lifetime.

A solenoid converts electrical energy into linear mechanical motion. So-called rotary solenoids have a linkage that converts the linear motion into rotary motion at an output shaft. All solenoids consist of a frame, a coil housed in the frame, a pole piece or backstop, and a plunger. Apart from serving as a coil housing, the frame forms a circuit for magnetic lines of force. When current flows through the coil, a magnetic field pulls on the plunger, causing it to move toward the backstop.

David Luckenbach is vice president and general manager of Magnetec Corporation, a subsidiary of Hi-G, Incorporated, 580 Spring St, Windsor Locks, CT 06096.

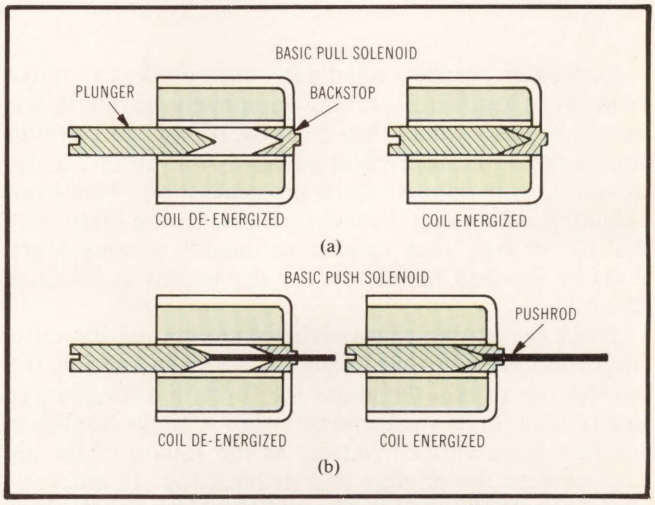


Fig 1 Basic solenoid. In (a), coil energy pulls plunger against backstop. Push solenoid, in (b), has pushrod attached to plunger that penetrates backstop

So-called push solenoids are simply pull solenoids with pushrods attached to their plungers through a hole in the backstop (Fig 1).

Although solenoid force depends primarily on the amount of electrical energy applied to the coil and the length of the plunger stroke, it is also a function of

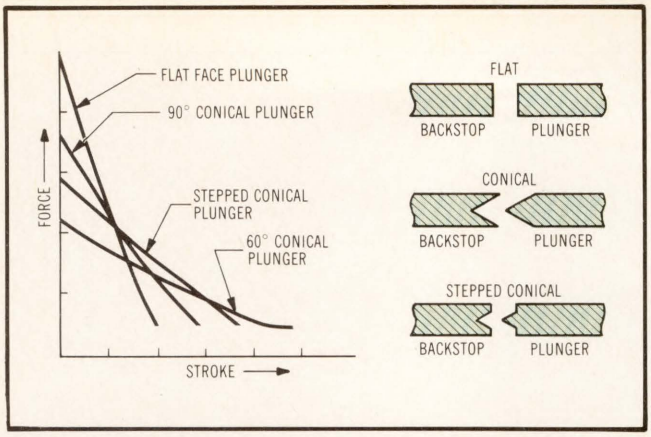


Fig 2 Force depends on geometry. Graph plots force per unit of stroke for dc solenoids with four different backstop and plunger geometries

plunger and backstop geometry. In general, plungers and backstops have flat, conical, or stepped conical faces. Variations in plunger and backstop geometry influence the output force (Fig 2).

A computer grade solenoid must operate much more frequently than, say, a solenoid in a washing machine. Since computer peripherals often occupy an office environment, high noise level can be objectionable. This, coupled with the need for sustained high speed operation, often means that a solenoid operates ballistically, without ever striking its backstop.

Solenoid force depends primarily on the amount of electrical energy applied to the coil and the length of the plunger stroke, but it is also a function of plunger and backstop geometry.

Computer grade solenoids are used to move read/write heads in recording equipment; as interlocks; and in printers where they perform ribbon shift during multicolor printing, ribbon advance and reverse, paper advance, and impact character generation. Printhead solenoids are among the most critical. Over a lifetime of 5×10^8 strokes, they operate as quickly as once every 2 ms or less and handle print pulse widths as small as 250 μs.

Force per stroke characteristics are among the most important solenoid specifications. As a general rule, the shorter the stroke, the larger the force that the plunger exerts. The force/stroke relationship is highly nonlinear because force varies inversely as the square of the air gap between the plunger and its backstop. In most applications, the overall stroke consists of two parts. Pre-travel is the distance a plunger travels before it picks up the load. Working stroke is the part of plunger travel that actually moves the load. Pre-travel is often maximized to gain more momentum and increase available force. However, total stroke must be as short as possible for greatest force.

The most critical point in the force/stroke relationship is usually that which lies furthest or most extended from the seated position. If, in fact, the component has the required operating force at this point, it will usually go in force with respect to distance at a rate in excess of what is required.

Keep it cool

Operating coil temperature influences the force that a solenoid can produce at its rated voltage. As coil temperature rises, coil resistance increases. This causes reduced coil current which, in turn, means less power for moving the plunger. Heat buildup can be reduced in several ways. The best approach is to use the shortest possible duty cycle. Using an oversized unit will help if space permits and power is available. Another alternative is to mount the solenoid on the largest possible heat sink. Finally, if other alternatives fail, forced air cooling will reduce heat buildup.

Turn it off

Whenever possible, the solenoid should be turned off. This will not only save power but will reduce heat. The reduction in heat will also make higher forces available in the lesser heated condition. The general rule that applies could be not to use duty cycles greatly in excess of the actual required function.

Spike it for fast start

Closely related to duty cycle is the fact that a given solenoid can be made to respond faster by briefly applying a higher voltage to its coil, a practice called spiking. Solenoid force increases in proportion to coil current. If current can be made to build up faster, solenoid force will develop more quickly. Consequently, in many applications, rated solenoid response time can be increased manyfold by applying a voltage spike of several times the rated operating voltage. Spiking is used extensively in computer applications.

The need for sustained high speed operation often means that a solenoid operates ballistically, without ever striking its backstop.

The need to switch high current into an inductive load at a high speed and frequency causes inductive "kickback," or extremely large voltage spikes that result from interrupting an inductive current. If not suppressed, these spikes can be many times the power supply voltage. They emit very undesirable noise. Various noise suppression techniques help combat inductive kickback (Fig 3). Among the simplest is a diode connected across a dc solenoid coil. Two diodes connected back to back form a remedy that is not sensitive

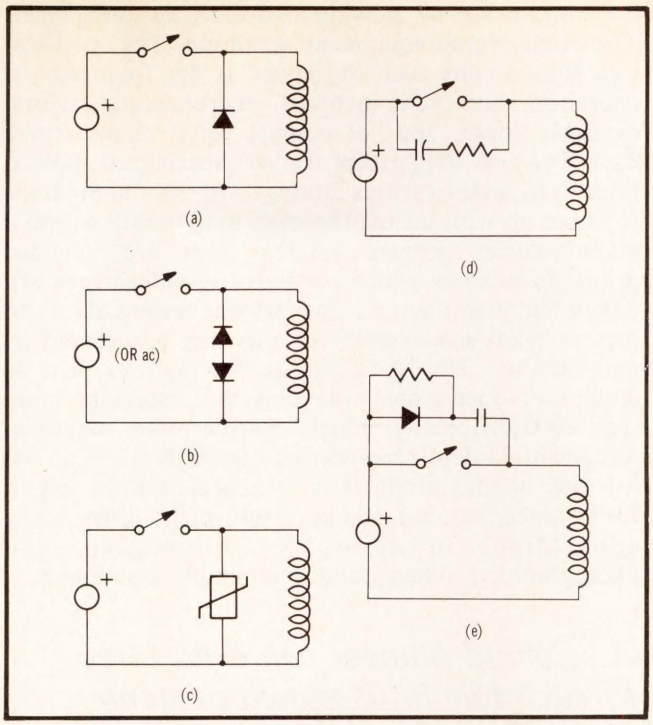


Fig 3 Noise suppression techniques. In (a) and (b), diode shorts out switched coil to suppress inductive spike. Varistor, in (c), serves same purpose. Conventional resistor and capacitor (d) shunt current around inductance. Dumping current into capacitor, in (e), suppresses noise without extending drop-out time

to polarity and can be used with ac or dc supplies. Varistors that drastically lower their resistance upon application of a large voltage have been used to short out a switched coil. Using a more traditional arc suppression circuit, a resistor in series with a capacitor connected across the coil will shunt coil current away from the inductance.

All of the arc suppression networks in Fig 3(a) to (d) have one drawback—they extend solenoid "drop-out" time by allowing current to circulate through the coil after it has been switched off. In applications that cannot tolerate even a small delay in coil current decay time, another type of arc suppression network can be used. As soon as the switch interrupts the coil current, coil energy in the form of current is dumped into a capacitor [Fig 3(e)], a fast process because only the low forward resistance of the diode and the coil's internal resistance limit capacitor are charging. Then, when the switch contacts close, the arc suppression capacitor discharges slowly through the resistor because the diode is now in its reversed position. If there were no resistor and no diode, capacitor discharge current could damage the switch.

Hold it with low power

Force versus stroke curves in Fig 2 show that a solenoid plunger can exert large forces while in its seated or home position. Consequently, holding current for a solenoid in a continuous duty application can be reduced when the plunger is fully seated. This will not only reduce power consumption but also permit the use of a smaller solenoid and perhaps extend solenoid life by lowering both temperature and overall stress. The change from operating current to holding current can be made in several ways. For example, a solenoid can be equipped with a single-pole, double-throw contact so that, as it moves to its home position, the plunger transfers the center contact from one side to the other (Fig 4). The solenoid coil is energized through contact A. Then, as the plunger travels home, it applies the supply voltage to contact B wired in series with resistor R. The resistance is selected to ensure sufficient current through the coil to maintain the plunger in the seated position.

Even more dramatic reductions in solenoid holding power have been made recently. A mechanical latching solenoid can move an external load upon application of a current pulse and hold the load in its seated position without further application of power. Another current pulse unlatches the solenoid and allows its load to return to its rest position. To ensure correct sequencing of the pulses and correct direction of motion, a positive position switch is added to a rear plunger extension. Current pulses are applied alternately between common contacts and either the normally open contacts or the normally closed contacts. If the solenoid gets out of sequence, it will miss a pulse and be back in phase. A single pulse applied at the beginning of any start-up function places the solenoid into the proper mode.

Benefits of these solenoid designs include conservation of energy through the use of pulsed power and the ability to hold a load in the solenoid's seated position without application of power. Also, a small solenoid can replace larger conventional types because coil windings designed for a pulse duty cycle achieve small coil volume and frame size. These savings reduce solenoid heat dissipation and increase the force developed by any particular frame size. They also minimize the effects of coil temperature; the attendant loss of force is virtually nil compared with solenoids operated with long "on" time pulses or continuous duty cycles. Mechanical latching solenoids do not generate a magnetic field during "on" time periods, and therefore do not interfere with sensitive components used near the solenoid.

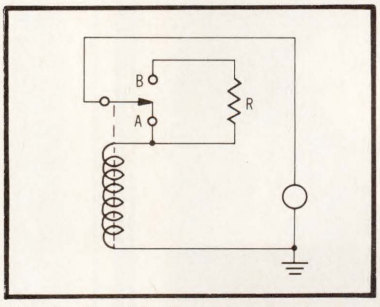


Fig 4 Double-throw contact reduces holding current. Contact A energizes coil. As plunger moves to home position, it switches supply voltage to contact B wired in series with resistor R

Selecting a computer grade solenoid

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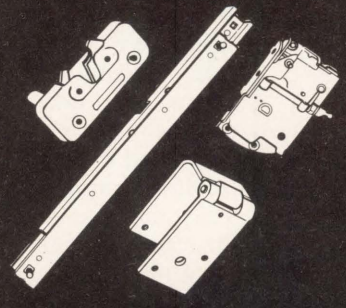
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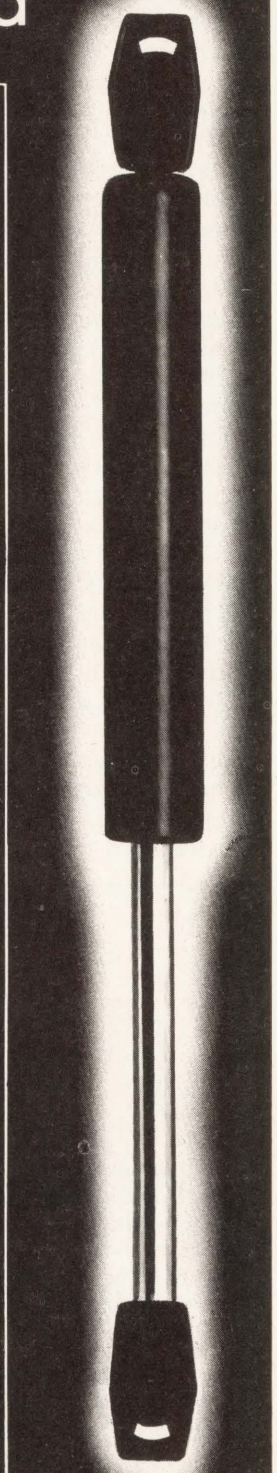
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it is best to start by drawing up a specification in terms of desired overall equipment operation. The specification should state such objectives as life frequency of operation, duty cycles involved, environmental factors, available space, and, of course, force versus stroke data. The next step, except for very specialized applications, is to review various catalogs. One should not hope to come up with an off-the-shelf unit. Many solenoid manufacturers prepare catalogs that are intended primarily to show which classes of solenoids they can design and manufacture. They do not necessarily try to present ready-made solenoids that can be ordered by part number. The Hi-G catalog, for instance, lists 26 models of open-frame solenoids that represent more than 2000 different products. Furthermore, manufacturers with in-depth engineering capability often do not list their special products in standard catalogs. Hi-G, for instance, has designed and built solenoids for many applications in aerospace, automotive, and photographic products, and in computer equipment.

A solenoid plunger can exert large forces while in its seated or home position.

Once a realistic specification has been prepared, the next step is to contact several manufacturers. Be prepared for comprehensive give-and-take discussions, and expect to make changes in both design and specification. At this stage, it is best to simultaneously evaluate the ability of prospective vendors to solve the problem at hand. Consider such factors as previous experience in the field, availability of engineering expertise, adequate production facilities, and quality control procedures.

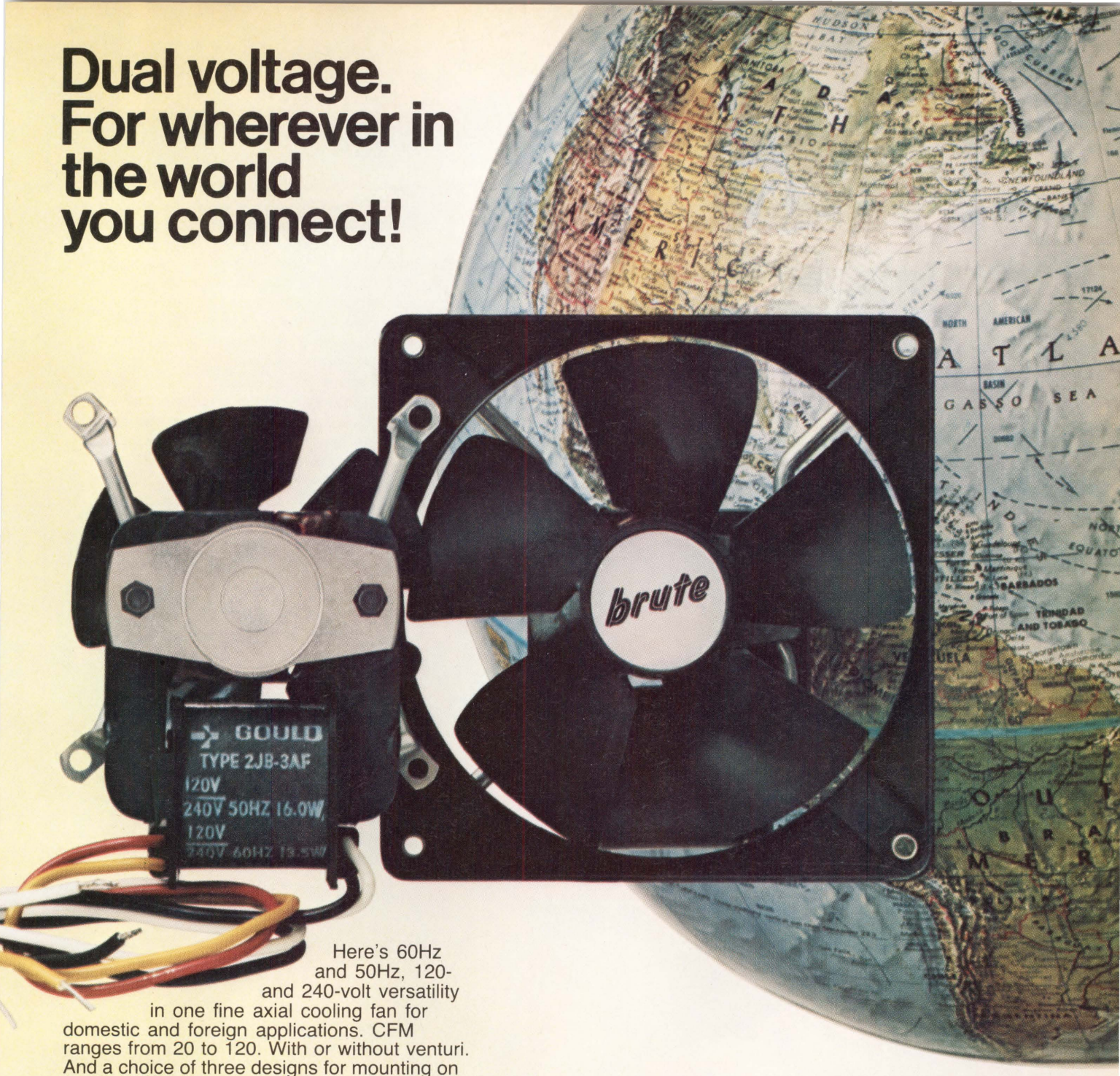
When reviewing quotes from selected vendors, determine why various manufacturers came up with different prices for seemingly identical products. For computer grade solenoids, which must meet severe demands on performance and life, a knowledgeable manufacturer will select suitable materials and enforce close tolerance during fabrication to make a product that meets all requirements. For instance, the product may include special coatings, special wire insulation, brass tubes (to reduce friction), a tight fit between plunger and coil, a means to ensure accurate plunger centering, a means to divert air from plunger movement, and so on. All of these imply added cost both in raw materials and in fabrication.

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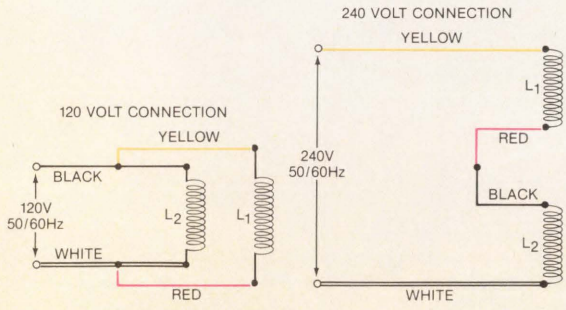


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LOCAL NETWORK ACCESS TRADEOFFS

Cost/complexity tradeoffs are examined in CSMA/CD and token passing techniques for accessing local area networks

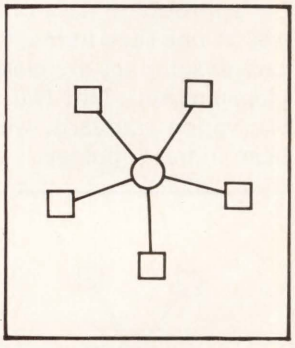
by Mark Stieglitz

Local networks are characterized by problems that are very similar to those encountered in conventional data communications networks.[1] Local networks, however, generate new problems and opportunities that require reconsideration of tradeoffs in system cost/complexity. A fundamental point of decision in local network design is the choice of access method. Chief contenders among access techniques are carrier sense multiple access and token passing.

What is a local network?

The current controversial nature of local area networks (LANs) is highlighted by their many definitions. A common theme in these is that the LAN be privately owned and/or administered by the user. An LAN need not be considered only as a high speed data transfer mechanism; current private branch exchanges also meet the definition of a private system. The opportunity to optimize the network for a particular user's application, therefore, becomes a key feature of the network. In this discussion we assume the following: that a local network is a privately owned communication system; it usually runs at data rates of 100k bits/s and above; and it is usually restricted geographically (100 to 25,000 m).

It is often asked if the X.25 protocol can be used in LAN applications, especially now that X.25 large scale integration (LSI) controllers are available. This question can be more readily answered by comparing LAN and X.25 protocol functions using the International Standards Organization Open Systems Interconnection (ISO/OSI) reference model.[2,3] The model was developed to help conceptualize the relationships of various elements in a communications protocol. The access function resides between physical and link level functions, often referred to as a link layer sub-layer (Fig 1). The primary difference is that the concept of a shared medium is foreign to X.25. Addresses at the link level are actually command/response indicators, since it is assumed that pairs of stations have point to point links between them.



The local network access layer implements both the device arbitration and addressing necessary for shared medium operation. Once this layer is chosen and implemented, it is expected that the remaining layers may be used in this new application with little change.

Network topologies

In simple terms, topology is the way in which networks are tied together (Fig 2). Many networks are wired in ring or star configurations in order to eliminate the contention problems that occur when more than one connected device tries to send data at the same time. The primary advantage of the bus topology is easy reconfigurability, more important, perhaps, than its reliability advantage. Costs of improving reliability in a star or ring network, eg, adding redundant subsystems, can be much less than reconfiguration costs of the same network over its lifetime. Reconfiguration is labor intensive, and the cost of labor is increasing at a faster rate than that of reliable electronics.

The security of a broadcast bus system is often questioned by users who are apprehensive of the party line

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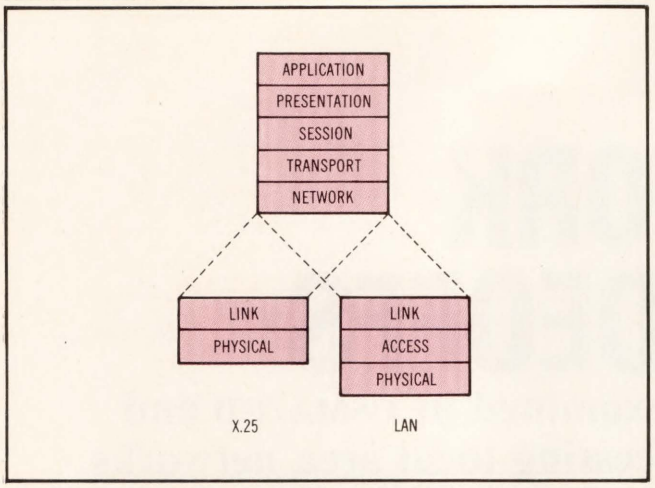


Fig 1 ISO/OSI reference model applicability. The model directly applies to local networks with addition of access layer

concept, where they share a network with diverse user groups. This problem is readily overcome by encrypting the appropriate data on the network. This alternative was at one time unfeasible because of high costs. Now several solutions are made possible by extensive LSI implementation of the National Bureau of Standards data encryption standard, which resolves this obvious problem in bus topology.

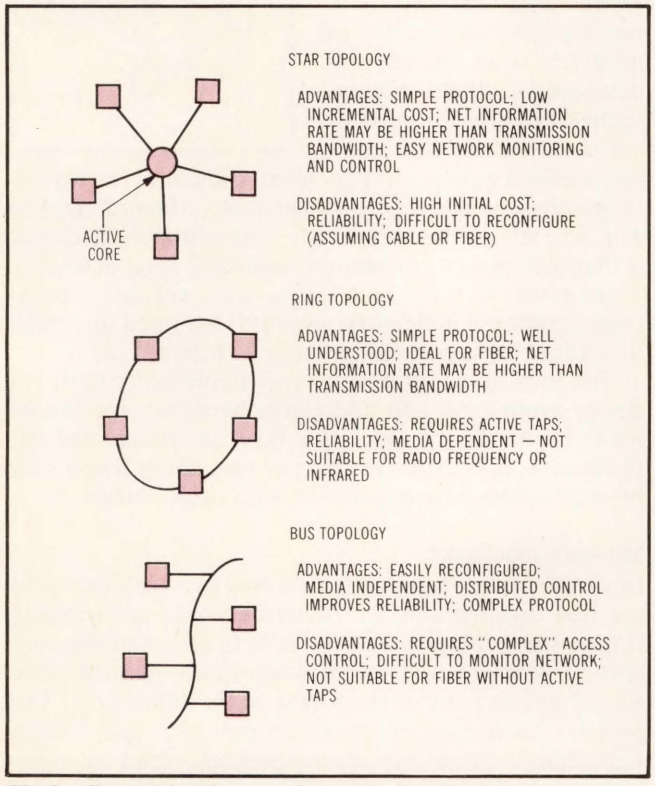


Fig 2 Typical local network topologies. Each has fundamental strengths and weaknesses. Bus topology's efficiency, maintainability, and cost are heavily dependent on access method used

Access methods

Currently the most controversial open question in the local network area is the choice of access methods in LAN buses. An access method is that part of a protocol that coordinates bandwidth use among all network subscribers. It ensures that only one station transmits at a given time, or, if more than one, that proper recovery action is taken to provide correct data transmission. Two common methods for allowing multiple transmission sources on a broadcast medium are frequency division and time division multiplexing (FDM and TDM). Both are fixed assignment schemes and require some centralized network intelligence to assign channels (FDM) or time slots (TDM). There are cost and reliability drawbacks to this centralized scheme. Also, it is difficult to effectively use the communications bandwidth where there are many sporadic data sources, such as word processing terminals. The solution to this lies in a demand access scheme, two of which are currently being promoted.

Carrier Sense Multiple Access (CSMA). In this method a station wishing to transmit listens first for channel clear, and transmits if such is the case. When two stations hear that the channel is clear and transmit simultaneously, a collision occurs. This must be detected and recovered by the CSMA protocol. The simplest type of collision detection requires a higher, usually link level, intelligence to note that a frame has been lost on the network. All frames would be buffered until acknowledged and retransmitted if no timely ACK is received.

Carrier sense multiple access with collision detection (CSMA/CD) is a CSMA implementation that can detect transmission collisions while the data are being transmitted. This enhancement greatly minimizes bandwidth wastage during collisions, but imposes a minimum size restriction on every frame to ensure that collisions are detected (Fig 3). A more serious drawback in collision detection is in its actual implementation. It must detect two simultaneous transmissions (a station's receiver must "listen" for others while its own transmitter is "talking"). Transceiver design is critical. Special cable and cable taps are often needed to minimize noise and impedance problems. Special installation and grounding practices that have been developed may necessitate additional training of cable installers and modifications to building codes. All these constraints have recurring cost implications. So, while many solutions have been implemented, some are costly, and each is media/speed dependent. Several different systems using CSMA/CD are commercially available. The most notable is Ethernet, a joint offering of DEC, Intel, and Xerox.[3,4]

The CSMA scheme is comparatively simple and has enjoyed much academic research, but it has some shortcomings. In the pursuit of simplicity, visibility of network errors and the potential for future upgrade have been sacrificed. Since CSMA allows and expects collisions on the transmission medium, it is difficult for diagnostic equipment to distinguish expected errors from those that are induced by noise or faults. Determinism, or the ability to guarantee the successful (no

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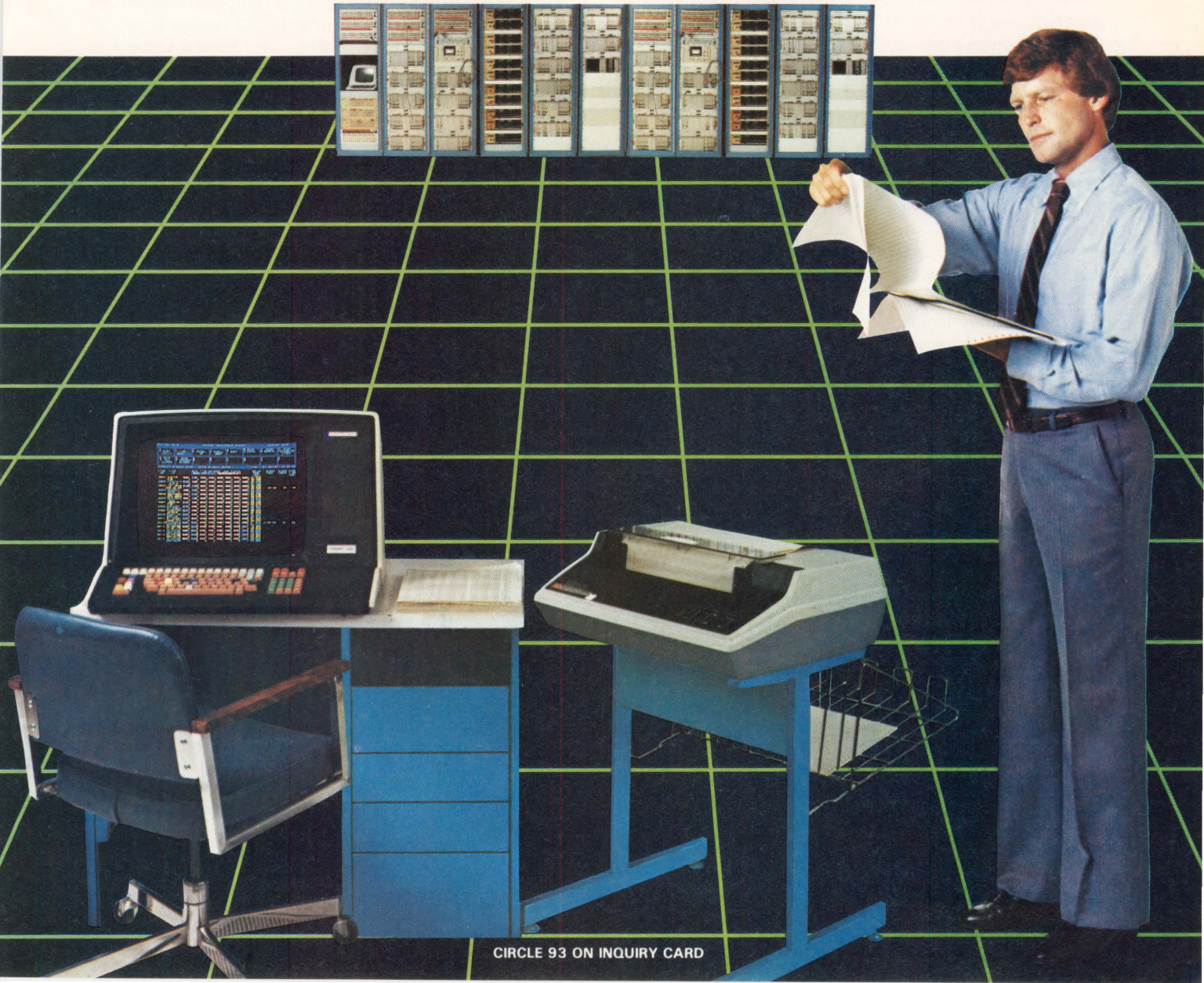
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collision) access of a station within a fixed time interval, cannot be accommodated in a CSMA environment.

Office automation, which is not real time and therefore CSMA compatible, is a major local network market. Process control, the other major application category, requires absolute delay limits and reliability guarantees. Both markets can be addressed with the same "standard" protocol and access method only if the needs of both are met. The token access method is a way to accomplish this.

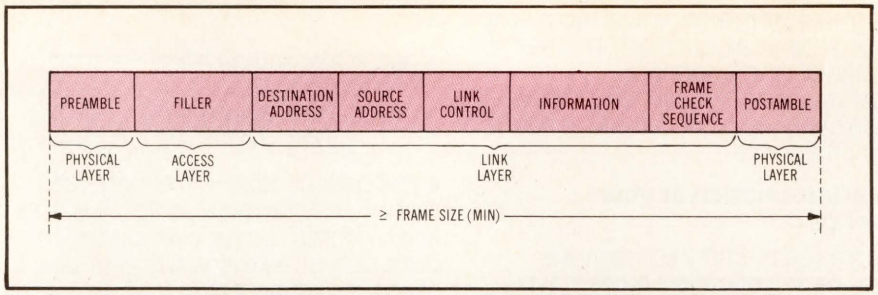


Fig 3 CSMA/CD frame. Filler is needed to ensure sufficient frame length for collision detection. Minimum frame length is function of propagation delay through maximum length of medium

Token passing. A token is an exclusive right, held by exactly one station at any given instant, to initiate transactions on the medium. Distributed network intelligence passes this access right around the network in a logical ring, resulting in an ordered and controlled access method. In the token passing scheme, sometimes referred to as "baton passing," each station sends a message to its access successor when it has finished its transactions (Fig 4).

Control messages are sent in the same format as is information, in frames. At first glance the token access scheme's frames look much like those of CSMA systems as shown in Fig 3. The similarities are purposely at the physical and link layers (Fig 5). The similarity ends with the access field; the required filler in CSMA/CD systems is replaced in the token passing frame with a token control field, usually of one octet.

The required control information could have been coded into the link level control field, but instead is placed directly ahead of the link field. There are three reasons for this. First, it provides adherence to the ISO/OSI model's sense of encapsulation. This says that a given layer must not modify or require the use of any data in a higher layer for its own proper operation. Observing this requirement saves software development and redevelopment as users switch between X.25 and LANs. Second, the ability to send "piggyback" tokens requires separate access and link control fields; link information can go to one station while control is (optionally) passed to another. This is an efficiency enhancement that allows a reduction in the bandwidth used for network management. Third, special format access frames can be sent. Since the access control field may be thought of as defining the rest of the frame (for example, an opcode), very short access frames can be transferred and evaluated without modifying link control programs.

While both access methods are conceptually simple, there are several implementation challenges in the token scheme. These include network initialization, building and maintaining the logical ring (online addition/removal of stations), and the resolution of fault recovery conditions. Centralized and fully distributed are two categories of solutions for these tasks.

The centralized scheme uses an administrative station to watch for and resolve unusual network conditions. Removing this chore from the bulk of the stations simplifies their processing requirements and thus their cost. This administrative method is also generally more expeditious than distributed schemes, since the latter require delays in their distributed algorithms and require all stations to rediscover their part of the network configuration each time.

In the distributed scheme, reliability and ease of configuration are achieved; the network configures itself each time it is initialized. The best of both worlds, speed and reliability, are achieved in the hybrid system. Here the distributed algorithms are retained as backup in case of an administrative failure.

The token protocol makes no assumptions about, or "improper" use of, the transmission medium or transmission rate. Any collisions are treated simply as manifestations of noise and are consistently handled as exceptions. No expected collisions mean no confusion as to cause, resulting in improved maintainability and serviceability. The use of strictly "inband" signaling allows true media independence. Radio frequency, infrared, CATV, baseband coaxial, fiber, and other broadcast media are usable with no change in the access algorithm or any sacrifice of efficiency. This flexibility will be useful as data rates and distances grow and as new transmission technologies are developed.

Inband signaling also means that existing components and technology can be used. This gives network

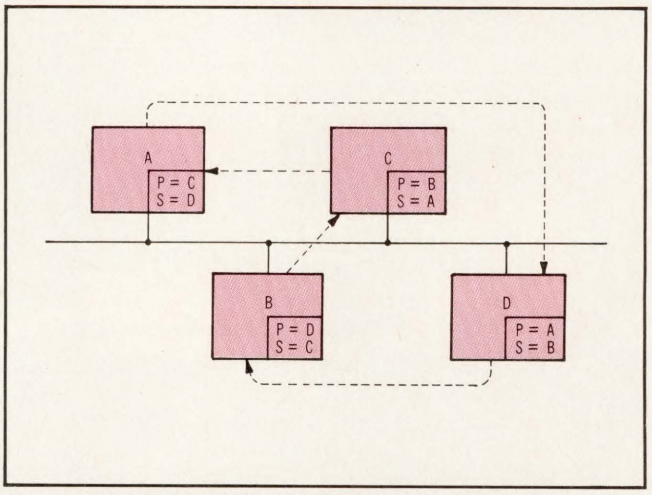


Fig 4 Model of logical ring. Each station has sufficient intelligence to receive and validate tokens from its predecessor (P) and send tokens to its successor (S). Physical ordering of stations is not relevant. Dashed lines indicate control flow

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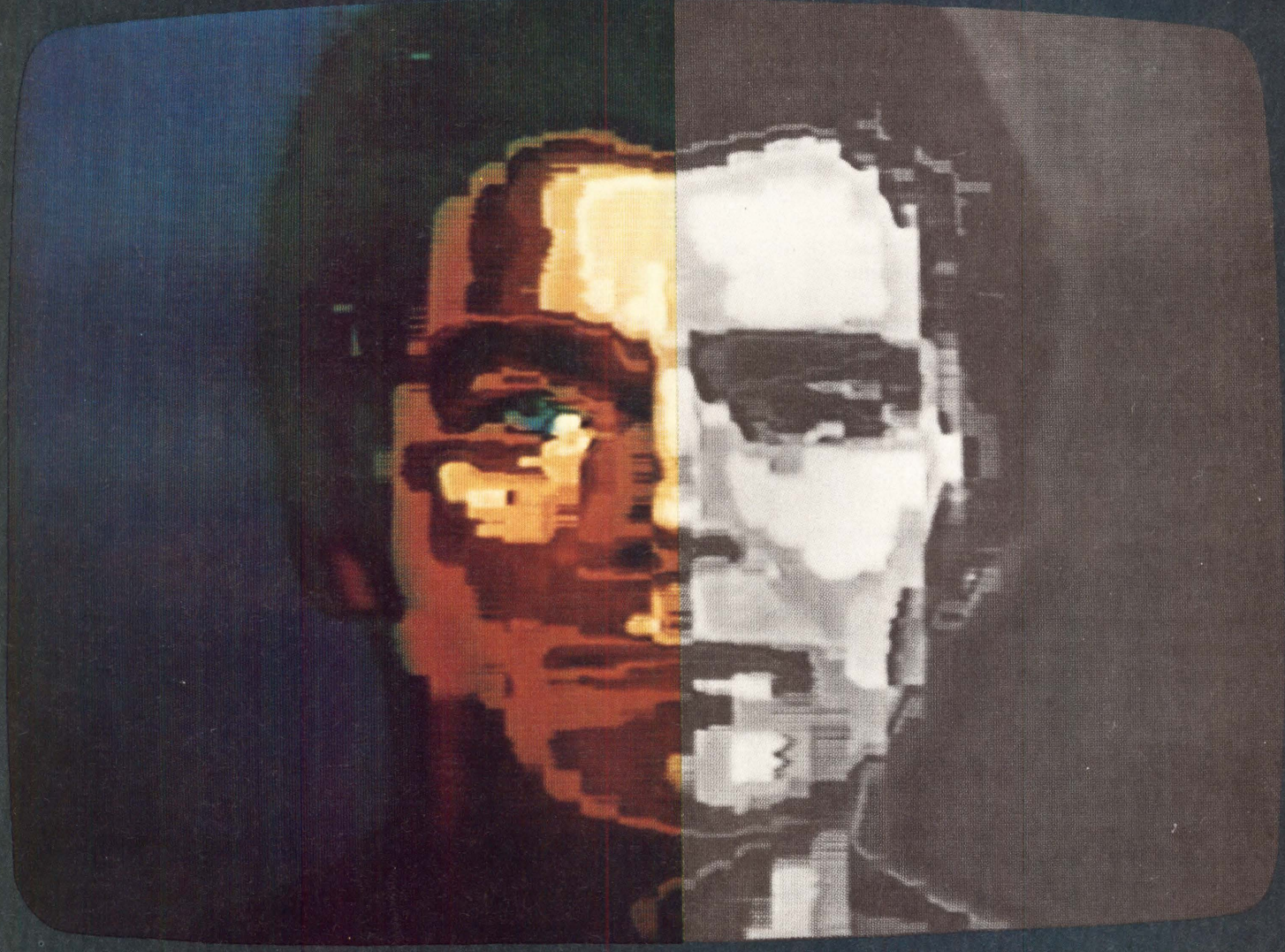
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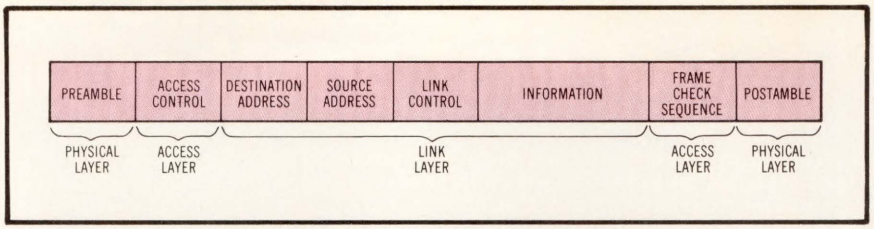


Fig 5 Token frame. Separate access control field allows option of passing control to one station while sending link level information to another

Token protocol's insensitivity to transmission speed is another important factor. It is unreasonable to assume that all network users need the same arbitrary data rate, such as 10M bits/s. Users with lesser requirements should be able to scale systems to their needs and budgets. Some CSMA implementations have minimum frame size restrictions that are directly based on the data rate and the physical length of the medium, to say nothing of the cost of multi-megabit hardware. There is no reason that a few cathode ray tube terminals cannot be linked together with inexpensive twisted pair cable, using the same token protocol and controllers as those used in applications with higher speed requirements.
tions with higher speed requirements.

Depending on the application, networks must either be fair (where all stations have equal access to the medium), or include some priority mechanism. The token access method supports both conditions by being generically fair, but also allows tuning of network and station parameters if desired. Features such as sending "n" frames while holding the token are easily supported. This allows prioritization of stations where some may be allowed to transmit more than others before giving up the token. The network may be set to guarantee access to all nodes within strict time boundaries, as required in control applications.

If tokens solve all LAN problems, why is there any controversy? The answer to this lies in the real and perceived complexities of the token access scheme.

Is token complexity worth it?

Complexity considerations must be evaluated on two fronts: technical (Can it be implemented reliably?) and economic (Is any additional incurred cost justified?). Intensive efforts by individual companies and standards groups have yielded some commercial offerings and several technical proposals. The token access method has been reviewed and evaluated by academicians, network implementors, and users. With the systems, models, and documents available today, it can safely be said that the token scheme is implementable.

The LSI developer is challenged to deliver this complex protocol at low cost. With such an LSI controller, a day can be envisioned when users need be as little concerned about low level network protocols as they are today with bit locations and formats on floppy discs. Efforts in protocol design are nonrecurring, but the benefit of a sophisticated, forward-looking design course will manifest itself more and more as network requirements grow.

Algorithm details and standardization

In the general token scheme just described, detailed algorithms vary depending on the system and design requirements. Choice of an initialization algorithm, for example, depends heavily on the address range allowed in the network: a 48-bit address range uses a different station sort scheme than does an 8-bit range. Work on the distillation of these tradeoffs is underway by standards committees and commercial organizations.

Standardization is key to volume manufacture of token controllers and to the interconnectivity of multivendor equipment. Standardization also advances the development of network diagnostic equipment and tools.

Summary and conclusions

A new science requires fresh consideration of engineering challenges. The needs of users and the progress of implementation technology, especially LSI, can be projected. There is no reason to accept any scheme simply because it exists, as proposed in References 5 and 6. Professional skill and judgment must be used in selecting all elements of any system, especially one as new and with such potential impact as the local area network.

The general token access scheme enjoys current commercial use, generality, and expandability that make it a truly useful standard. Investment costs in up-front complexity will be continually reduced with further LSI developments and as network uses proliferate.

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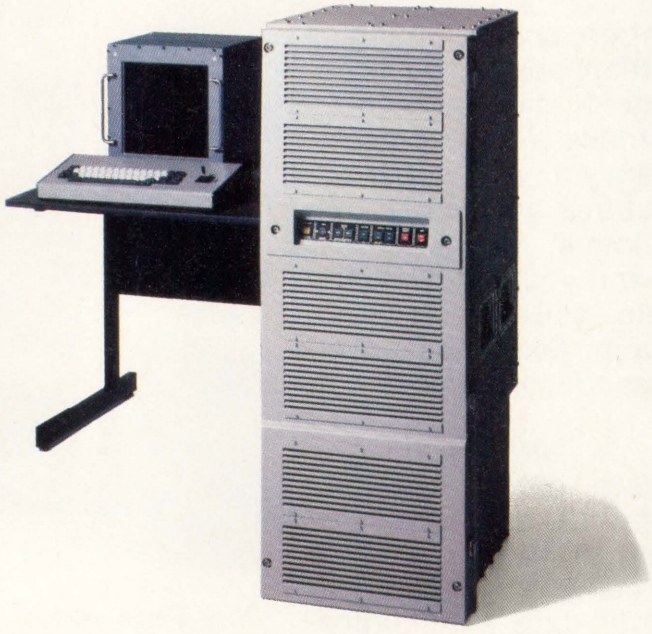
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11/70M	MIL-E-5400 MIL-E-16400 MIL-E-4158	128 KB	16	4 MB	3.5 ft.^{3}	5.8 MB/Sec.	600 KOPS	2 KB System
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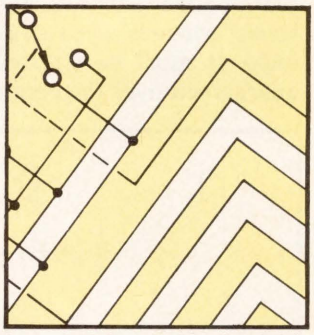
SEGMENTED LADDER IMPROVES DAC PERFORMANCE

Proprietary segmented DAC offers 13-bit differential nonlinearity without thin film resistors and/or active trimming

by Brian Gillings

Departing from the traditional R-2R design, a proprietary segmented digital to analog converter offers inherent monotonicity and differential nonlinearity as high as 13 bits (0.012%). Performance of the converter is immune to variations in temperature, time, process, and mechanical stress. Built using standard processing without the requirements of thin film resistors and/or active trimming of individual devices, the Am6012 converter offers a differential nonlinearity of ± ½ least significant bit. A uniform step size allows finer resolution at each level than is possible with traditional digital to analog converters. In most applications, uniform stepping proves to be more useful than conformance to an ideal straight line from 0 to full scale.

The transfer characteristic for a segmented ladder in the Am6012 is shown in Fig 1. The 4096 output levels are in 8 groups of 512 steps each. Each step is generated by a 9-bit digital to analog converter (DAC) and each segment slope is determined by 1 of 8 equal current sources, as shown in Fig 2. Resistors that determine monotonicity are in the 9-bit DAC. Since the major carry of the 9-bit DAC is repeated in each of the 8 segments, the need for initial resistor accuracy is eight times lower. This also provides tracking to maintain a given differential nonlinearity over temperature.



If we assume that the input code is all 0s, the first segment current I_0 is divided into 512 levels by the 9-bit multiplying DAC and fed to the output IOUT.

An increasing digital input code selects a new segment for every 512 counts. The previous segment is fed to output IOUT, where the new group is added to it, thus ensuring monotonicity independent of segment resistor values.

In the segmented DAC, the precision of the 8 main resistors determines linearity only. The influence of each main resistor on linearity is four times lower than that of the most significant bit (MSB) resistor in an R-2R DAC. Thus, if the resistor tolerances were the same, then the segmented approach would actually be higher in linearity than that of the R-2R design.

The 9-bit DAC is composed of a master and a slave ladder. The slave ladder generates the 4 least significant bits (LSBs) from the remainder of the master ladder by using scaled emitters to split the current actively. All of the current switches in the step generator are fully differential, capable of switching low currents at high speed. This allows the use of a binary scaled network to the LSB, saving power and simplifying the circuitry.

Brian Gillings is manager of linear product planning and applications at Advanced Micro Devices, 901 Thompson Pl, Sunnyvale, CA 94086. Prior to joining AMD, he was analog project manager at Data Laboratories Ltd, Mitcham, England, and design engineer at the Independent Broadcasting Authority, England, working on digital television.

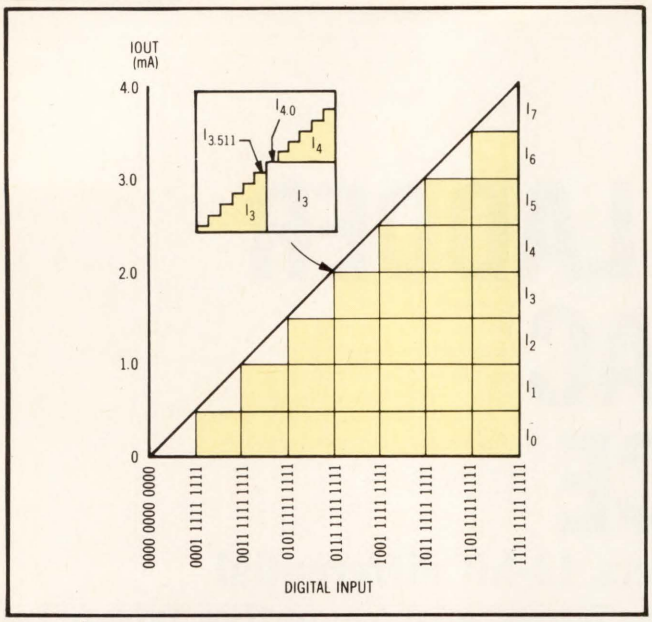


Fig 1 Transfer characteristic of segmented design used in AMD's Am6012 DAC

Specifications for the 12-bit DAC described here include 13 bits of differential nonlinearity (DNL) over temperature, a level of performance generally not available in other 12-bit converters even when using thin film resistors. This ± ½ LSB (13-bit) DNL guarantees that the converter has 4096 separate and distinct output levels, whereas a ± 1 LSB DNL guarantees monotonicity only. It must be stressed that these DNL figures are guaranteed over the complete temperature range. Also, DNL gives a measure of curve smoothness. The DAC transfer function may be more than 1 LSB nonlinear and yet be smooth and useful with ½ LSB DNL. This is especially true in video and graphics applications, where the human eye has difficulty discerning nonlinearity of less than 5%. In most applications, 12-bit resolution and DNL are more important than integral nonlinearity.

Voltage outputs

The settling time for the Am6012 (250 ns, typical) is specified for the current mode, which is the faster mode. Many DAC applications require a current to voltage conversion, which can be achieved simply by connecting a low value resistor directly to the output. If the output current is 4 mA, a unipolar output will limit the resistor value to 1.25 kΩ to ground because of the −5-V DAC output voltage compliance limitation. Output settling time is determined by the resistive-capacitive (RC) time constant produced by the DAC output capacitance of 20 pF (plus stray capacitance) and the value of the load resistor. Settling to 0.01% (± ½ LSB) of full scale would require approximately 300 ns, or 9 time constants. An op amp is required if lower output impedance or larger output swings are desired, but some settling time will be lost because the output response is limited by the amplifier's slew rate and settling time. A feedback capacitor, C_f, can compensate for the pole produced by the DAC output capacitance, op amp input capacitance, and the feedback resistor. Careful selection of this capacitor also optimizes the response time.

Fastest operation is achieved by minimizing lead lengths, impedances, and stray capacitances, bypassing the supplies to the DAC and op amp.

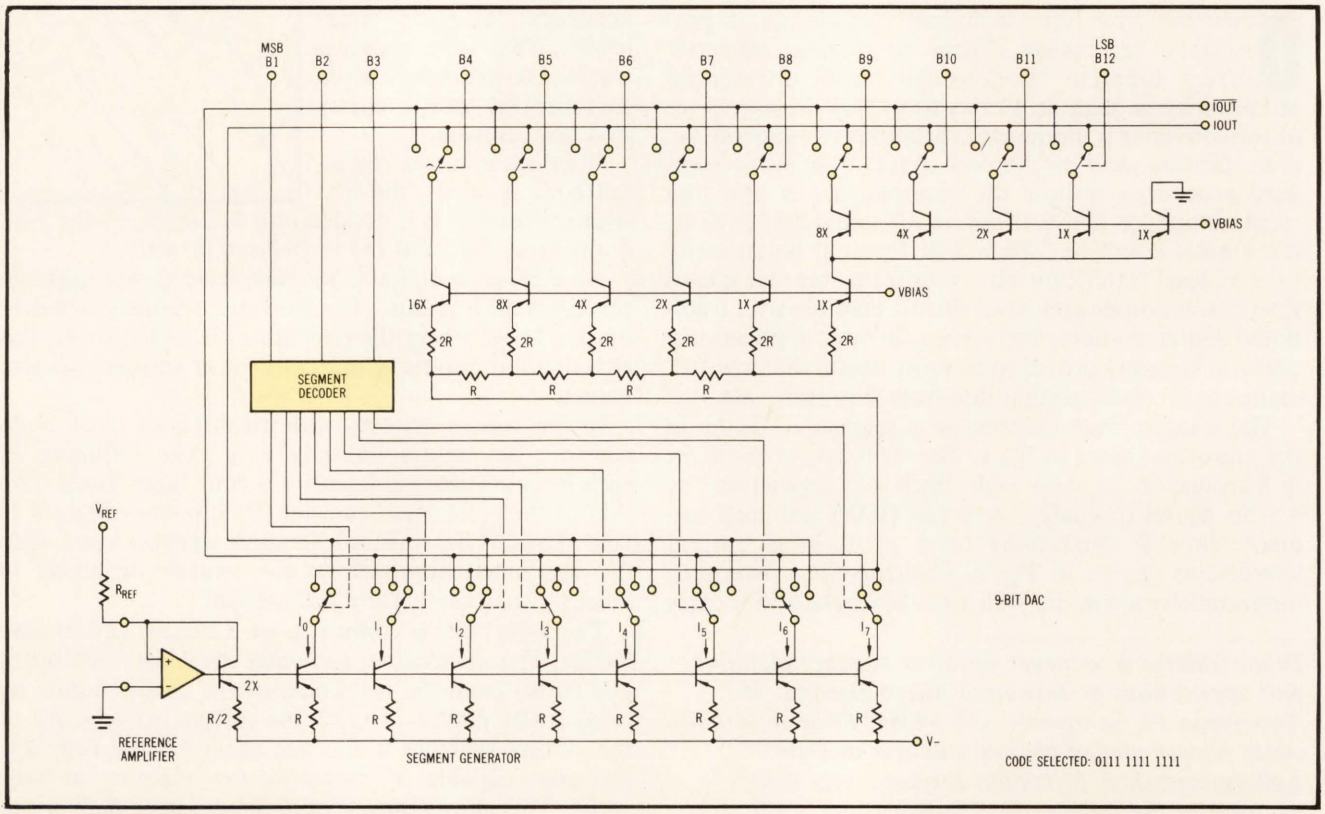
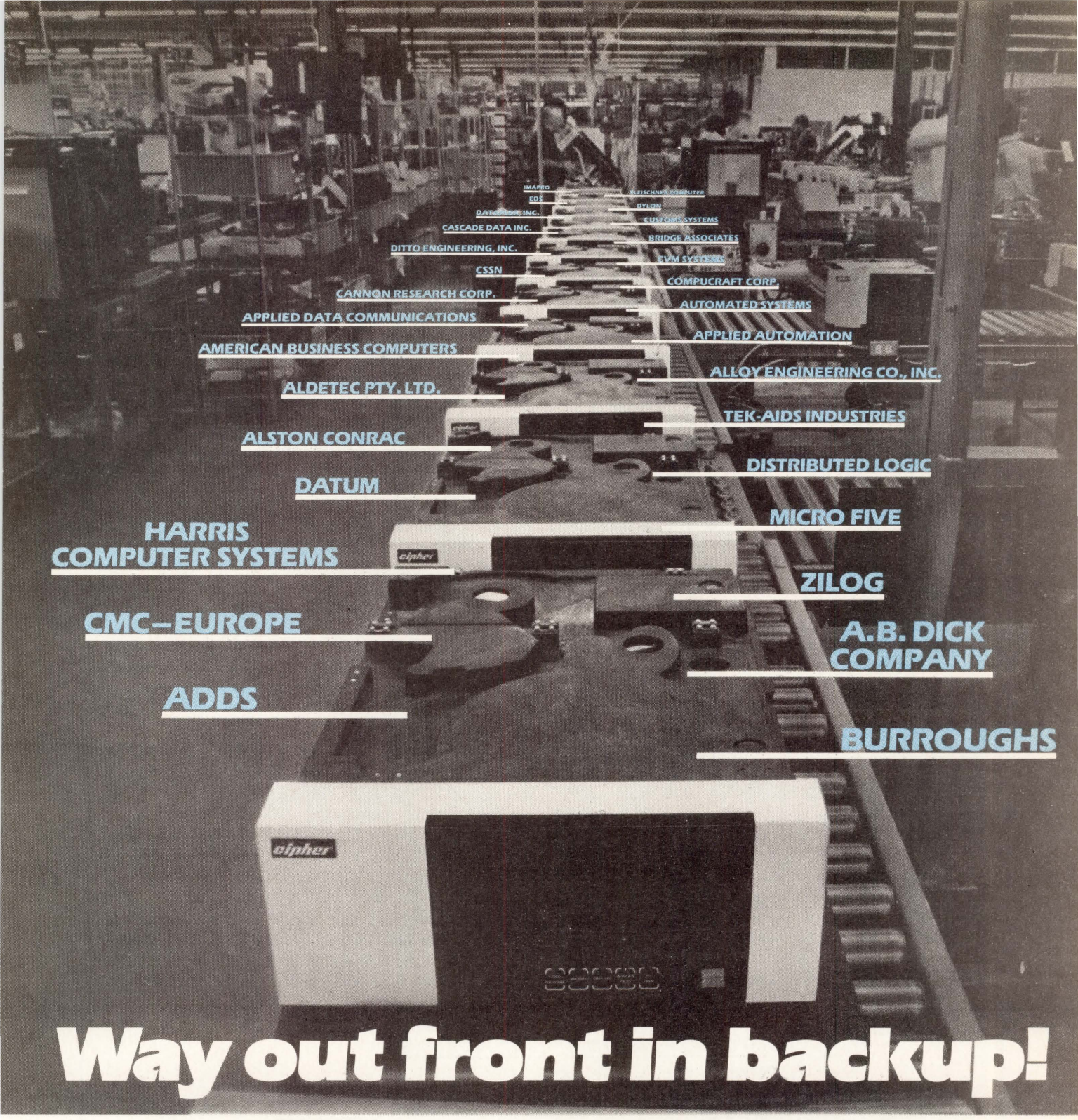


Fig 2 Segmented DAC functional diagram



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Use with ADCs

Successive approximation is probably the method most widely used for implementing an analog to digital converter (ADC), offering relatively fast conversion time with few components. Requiring n comparisons for an n-bit conversion makes the technique capable of high speed.

The MSB is turned on first, and the DAC output is compared with the input. The bit is switched off or left on, depending on whether the input signal is smaller or larger than the DAC output signal. The remaining bits are successively switched on and comparisons made until all respective bits are either left on or switched off. Each time one bit is tried, the DAC is required to settle to within ± ½ LSB. The successive approximation register (SAR) contains all the necessary analog to digital (A-D) logic. Holding the start input low for at least one clock period initiates the conversion. The MSB is set low and all of the other bits are set high for the first trial. Each trial takes one clock period, proceeding from the MSB to the LSB.

The time required to complete a 12-bit successive approximation A-D conversion is determined by adding the duration of the 12 trials, the comparator decision delays, and one clock cycle. Three dynamic considerations must be taken into account: the DAC output current settling time to ± ½ LSB; the comparator propagation delay; and the SAR propagation delay and setup requirements. For example, with 300 ns allowed for the DAC to settle to ± ½ LSB, and 300 ns for the comparator response time plus 50-ns SAR logic delay, a complete conversion could result in 8.5 μs.

A major factor affecting the settling time of the DAC is the RC time constant formed by the input resistor and the DAC output capacitance, plus any stray capacitance present at the summing node. The settling to within ± ½ LSB at 12 bits (±0.01%) requires 9.2 RC time constants. Thus the DAC, with an output capacitance of 20 pF, would influence the settling time if the input resistance were around 300 Ω. But input resistance would become the dominant factor when greater than 500 Ω. Hence, if the A-D full-scale range was 10 V and the DAC current 4 mA, then the input resistor would be equal to 2.5k, resulting in a 50-ns time constant and a settling time of approximately 500 ns.

Lowering the effective resistance at the summing node is a compromise between DAC settling time and comparator overdrive, because the ½ LSB current is only 0.5 mA, and, for an equivalent resistance of 500 Ω, would only result in a DAC output voltage corresponding to ½ LSB or 0.25 mV, which is inadequate for most comparators. With an input resistor of 2.5k, this would result in ½ LSB of 1.25 mV, which is an adequate overdrive for the comparator, producing a response time of 200 ns. The propagation delay of the SAR is 50 ns. Hence, the total conversion time for a full-scale signal range of 10 V is 11.5 μs.

ADC input impedance changes during the conversion process, and can alter the performance of the input or sample and hold amplifier. Because the comparison point can swing by a large amount, input current can be modulated. Output impedance of the input amplifier is brought low by the loop gain of the feedback amplifier. This gain decreases at high frequencies, and the output impedance rises to its open loop value, which is usually between 10 and 200 Ω.

Errors can be introduced into the instantaneous input voltage if the amplifier's bandwidth is insufficient and the output of the input amplifier does not return to its normal voltage before the converter makes a comparison. The DAC offers dual complementary outputs that can present a constant load current to the input signal, significantly reducing switching transients and increasing system throughput. Full-scale output current is 4 mA, allowing the use of relatively small load resistors. This minimizes the output RC delay that usually dominates the settling time for a 12-bit ADC. In the design of high resolution, high speed ADCs, the analog

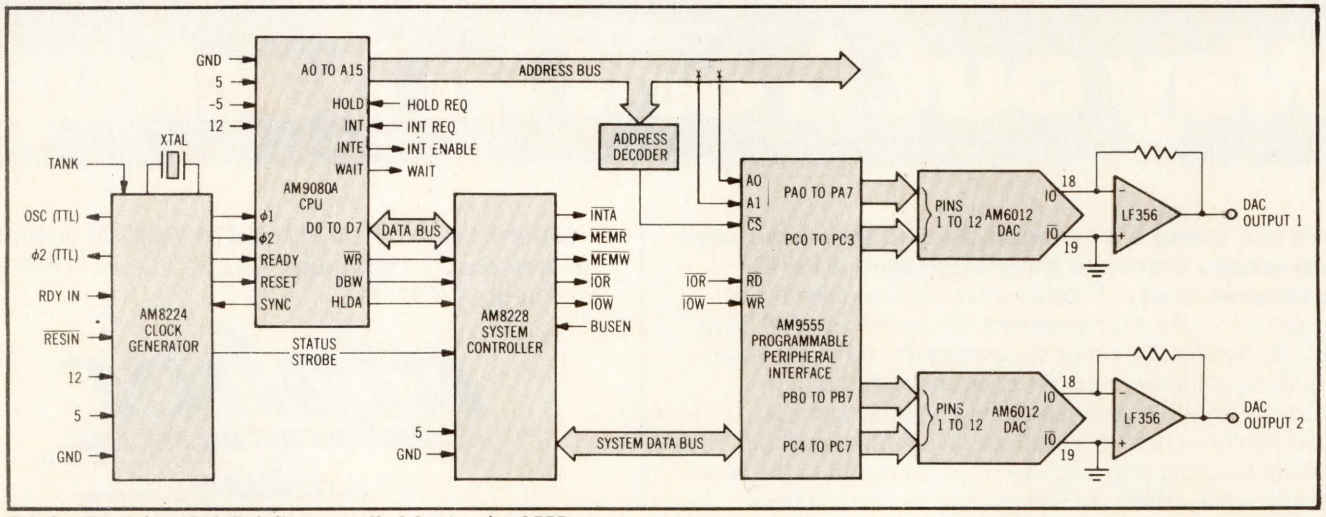
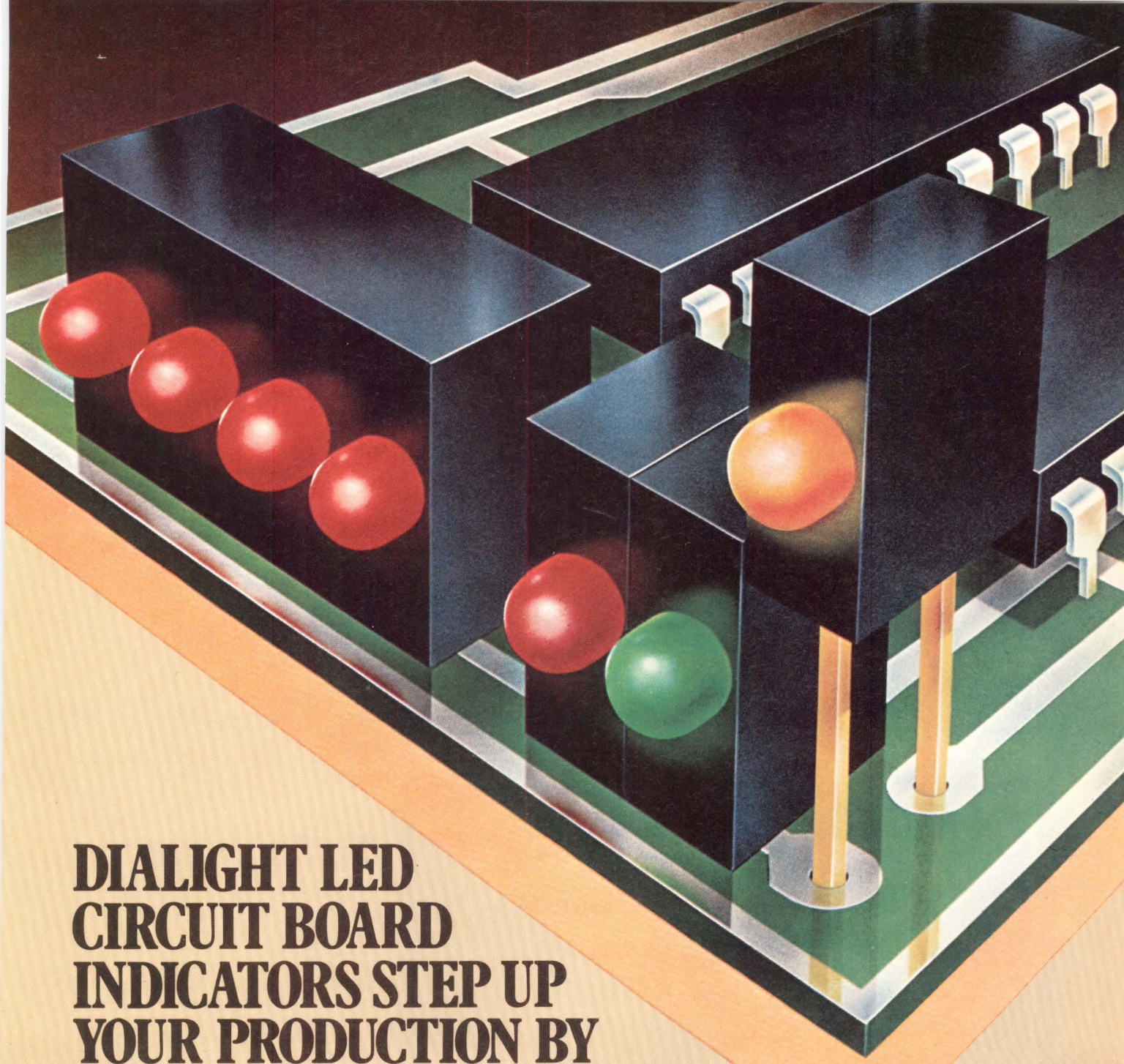


Fig 3 Two Am6012 DACs controlled by an Am9555 programmable peripheral interface



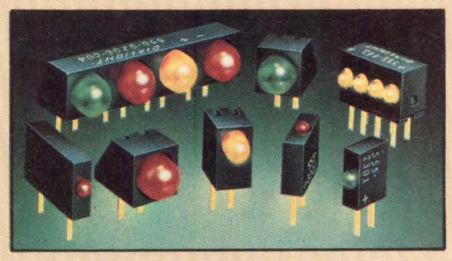
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signal path must be as short as possible and separate from the vicinity of digital lines. This precaution is especially important for the comparator output, which can capacitively couple edge transients back to the input of the comparator and cause the comparator to oscillate.

Digital and analog grounds should meet at one point only, to prevent digital ground currents from creating voltage errors in the analog ground. Ground loops should also be avoided within the analog sections, since they can introduce errors. High speed, high resolution ADCs must bypass supplies adequately. High frequency ceramic and tantalum capacitors should be used to decouple the high frequency components of the digital switching transients.

Microprocessor based system interfacing

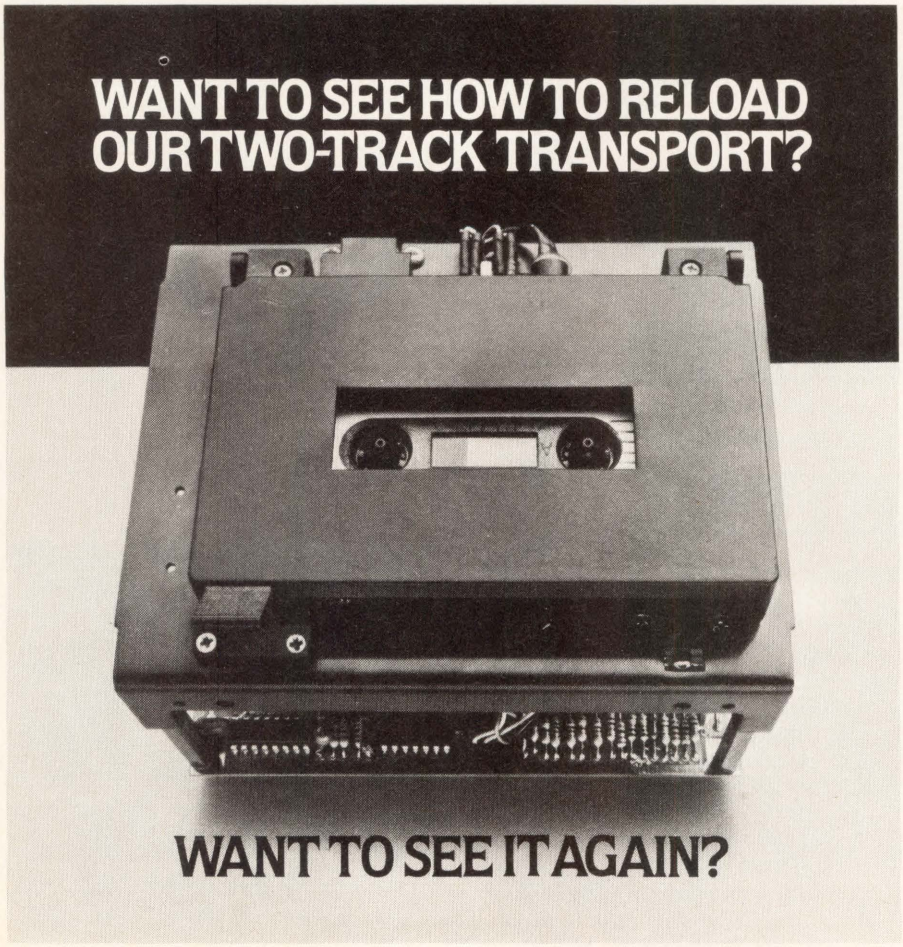
The DAC can interface to a microprocessor based system. The problem of interfacing microprocessors with an 8-bit bus to a 12-bit DAC is solved by breaking the 12-bit word into 8- and 4-bit bytes, storing each in a memory location. Fig 3 shows two 12-bit DACs interfaced to a central processing unit through a programmable peripheral interface. For a simpler system, the peripheral interface could be replaced by a 12-bit latch and control logic.

Summary

Easily interfaced to ADCs and microprocessors, the proprietary 12-bit monolithic DAC described in this article is the first to use standard processing without the requirements of thin film resistors and/or active trimming of individual devices. The result is a high speed, high accuracy converter available at a low cost. A segmented transfer function provides finer resolution of levels than traditional techniques that rely on conformance to an ideal straight line from zero to full-scale level.

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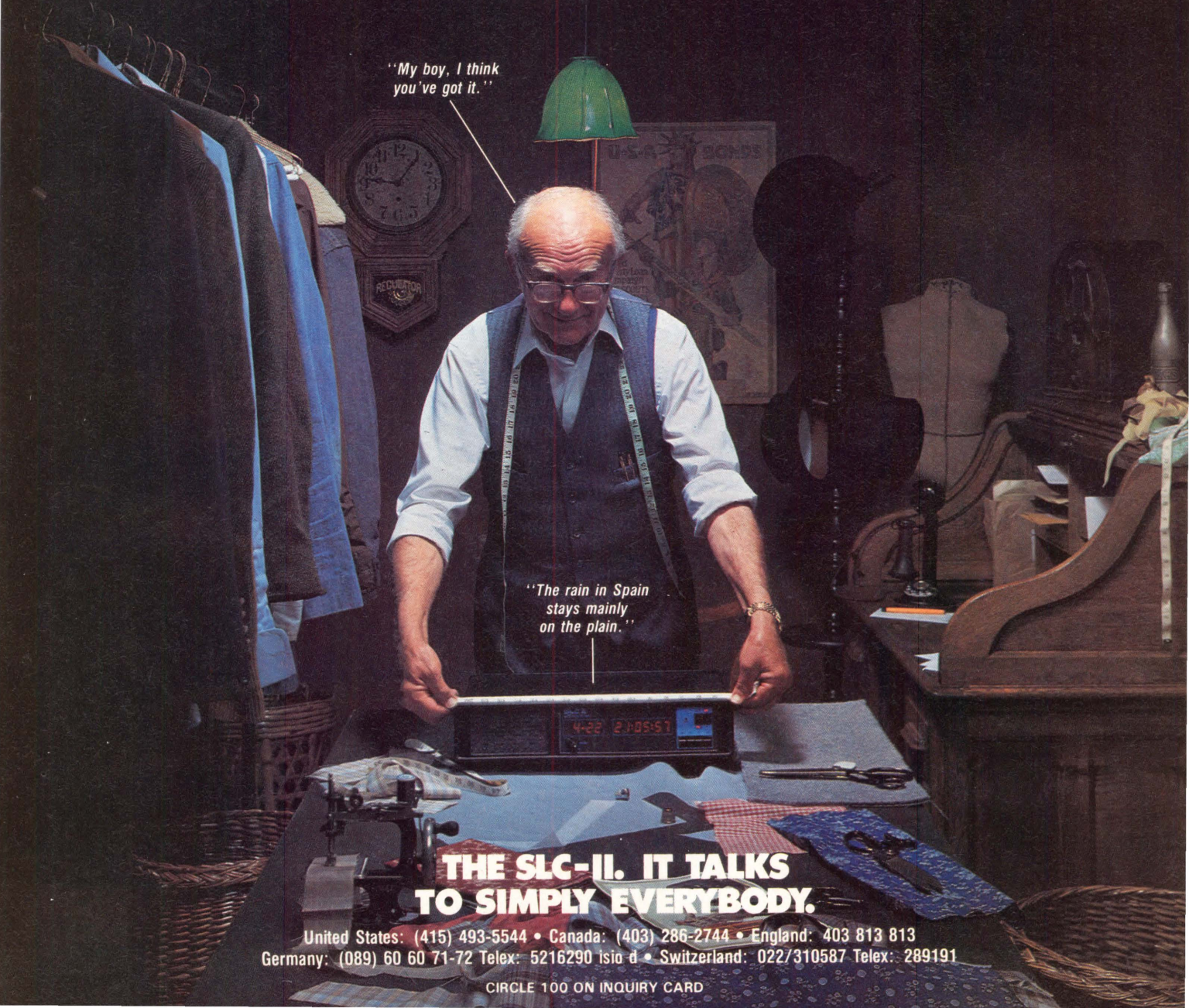
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COMMON ELEMENT KEY TO MULTIPROCESSOR ARCHITECTURE

A hierarchy of buses and a triple-bus interface overcome multiprocessing drawbacks

by William S. Ang

Multiprocessing—the interconnection of several processors to obtain the advantages of large computer power at small computer price—is relatively easy to achieve using microprocessors. Because system response normally degrades when peripherals are added, the need for multiprocessing capability is often clear at the start of a system design project. Degradation is caused mainly by contention for the processor and bandwidth limitations of the system bus. A multiprocessing system reduces contention by dividing tasks among a master processor and one or more subordinate processors. It relieves the bandwidth bottleneck by transferring data among processors and peripheral devices on subordinate buses, thereby freeing the system bus. Such a system also provides a flexible basic structure that is easily configured for a wide range of specific applications.

Multiprocessing systems can be organized in many different ways. One common approach adds several input/output (I/O) processors to support the main processor, with each I/O processor performing a special function. For instance, a multiprocessing system might contain a main processor, a communication channel processor, and a disc file processor. The special function processors are usually incorporated into peripheral device controllers which then become intelligent controllers.

Another design approach for multiprocessing systems is to build intelligent channels using specialized processors to operate peripheral device controllers. An intelligent channel usually provides two interfaces. One is a rather restrictive I/O interface that attaches to a device controller; the other is a direct memory access (DMA) connection to the system bus.

Drawbacks plague known techniques

Both multiprocessing system design approaches suffer from several shortcomings. Their I/O processors are too highly specialized. When many different types of special purpose processors are introduced into a system, support requirements increase enormously. Furthermore, a peripheral device controller that operates with an intelligent channel could be overkill in a relatively small system, one in which the main processor is capable of handling all peripheral devices directly. Extra processors make small systems unnecessarily complicated to program.

Another shortcoming is that the rather restrictive addressing and arithmetic capabilities of an intelligent channel may not suffice to perform complex file processing tasks required of a main processor. Finally, the DMA interface for an intelligent channel provides a means by which only the I/O processor can perform high speed data transfers to the main processor. In a multiprocessing environment, it is preferable for high speed transfers to be spread among many processors.

A multiprocessing system design that overcomes all of these shortcomings can be organized to form many different systems ranging from a simple, single-processor configuration to a complex nine-processor configuration. It accommodates a master processor and up to eight subordinate processors. Some of the subordinate

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processors can be used as I/O processors that support peripheral devices. Other subordinate processors can perform computational tasks similar to those that run on the main processor.

Common element is key to new approach

In one unique design, the 8086 microprocessor is used throughout as a common intelligent element. Use of only one kind of microprocessor makes one set of diagnostic programs applicable throughout the system. It also relieves hardware and software engineers from having to work with many different instruction sets and development tools.

A common hardware module can serve as any one of the eight subordinate processors. A subordinate processor becomes a communications processor if its main task is to control a high speed synchronous channel; it becomes a file processor if its main task is to process data files, and so on.

The design allows up to nine distinct buses to transfer data among system components. Eight are subordinate buses; and the ninth is the system bus. A subordinate bus is used only by a subordinate processor, its local memory, and the peripheral device controllers attached to the subordinate processor. The eight subordinate buses allow subordinate processors to operate simultaneously as independent subsystems. Although the system bus is used mainly by the master processor, occasionally subordinate processors use it for control functions or interprocessor data exchange. Subordinate bus functions are equivalent to system bus functions. Both buses can access a full megabyte of memory and 64k bytes of mapped I/O space. The major difference is that the system bus provides multiple-master operations while the subordinate bus is for single-master operation only.

Most of the peripheral device controllers have two interfaces, one for use with a subordinate processor through its subordinate bus, and another for occasional use with the other processors attached to the system bus. High speed peripheral controllers have large buffer memories, typically 1k bytes or more. Master and subordinate processors can directly access buffer memory in the controllers. This allows fast memory to memory data movement using the 8086 string handling instructions. Large buffer memory eliminates the need both for DMA in high speed controllers and for a specialized I/O processor. Removing the DMA function from the peripheral controller also simplifies implementation of the subordinate bus and allows it to be a single-master bus.

A hierarchy of specialized buses

The system bus provides eight pairs of parallel priority bus request and grant signals for the subordinate processors to request bus usage from the master processor. Parallel priority avoids discontinuities on the bus backplane, that might be caused by a serial priority scheme, by allowing system components to occupy any backplane slot without regard for their relative positions. The advantage of serial priority, which allows an unlimited number of bus masters to request the system bus, is not salient since most of the high speed controllers need not become masters for DMA operations.

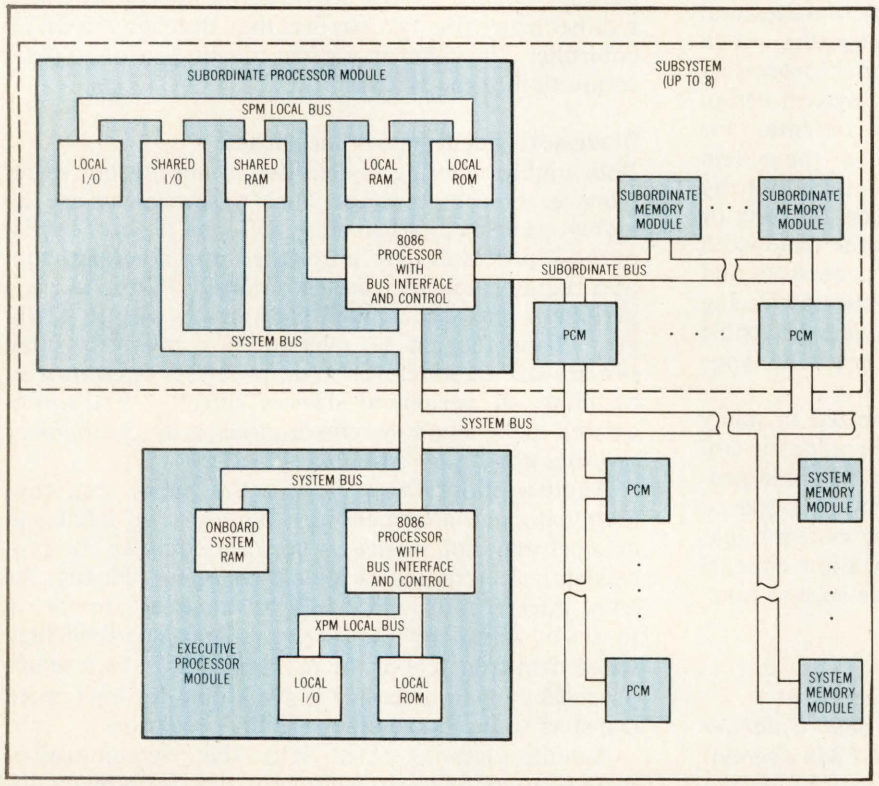
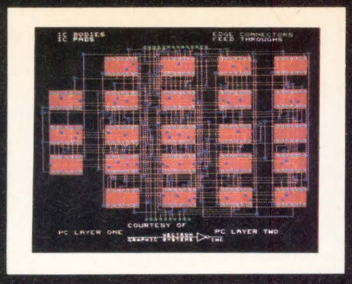
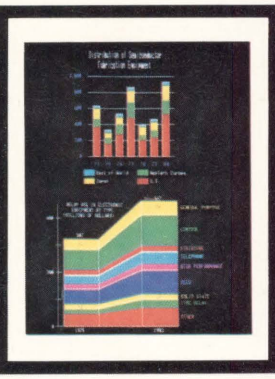


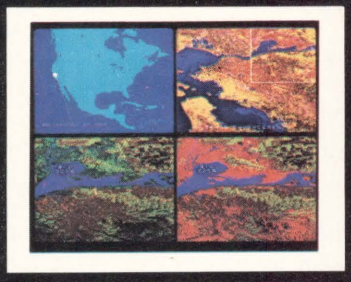
Fig 1 Multiprocessor architecture. Main system (lower half) has XPM, PCM(s), and memory module(s). Each of up to eight subsystems has SPM, additional PCM(s), and additional memory module(s). Bus hierarchy includes system bus, subordinate bus for use within subsystem, and local bus for use within XPM or SPM

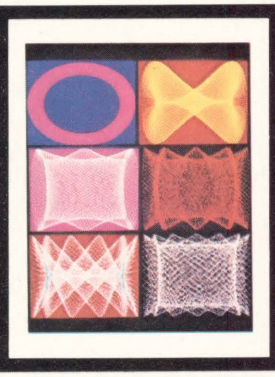
The system bus is designed for easy interfacing of subordinate processors. Unlike some popular system buses that require the next bus master to monitor bus usage and take active bus control only after the current bus master relinquishes it, this system bus priority circuit does not generate the bus acknowledge signal until the bus has been released by the current master and is ready for use by the next requesting master. The design relieves each bus master from having to implement a complicated bus monitoring circuit to actively take control of the bus.

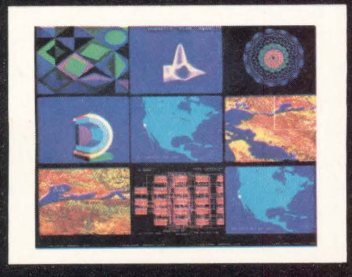
Each subordinate processor has a triple-bus interface, allowing it to operate with the system bus, a subordinate bus, and a local bus. The hardware module housing a













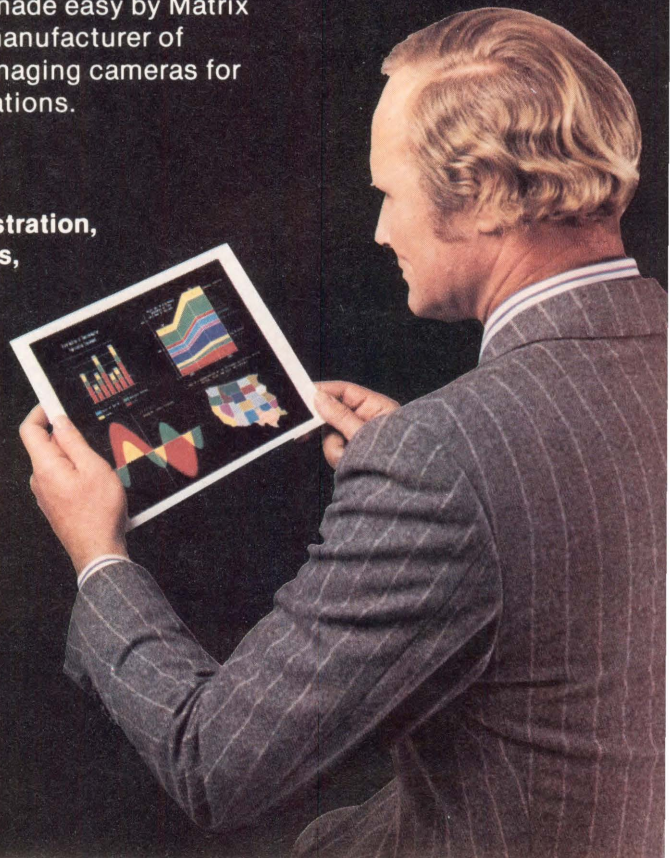
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subordinate processor provides onboard memory and I/O components that a subordinate processor can access through its local bus interface. The 64k bytes of onboard, dual-port memory have one port for operation with the subordinate processor, and a second port for operation with the system bus as a segment of system memory. When operating as a system memory segment, the subordinate processor's memory can be accessed by the master processor and by other subordinate processors. The lower half of the onboard memory is accessible only to the subordinate processor.

A customized multiprocessing architecture includes a main system and up to eight subsystems (Fig 1). The main system and subsystems each house one or more peripheral device control modules (PCMs) and one or more system memory modules. The main system has an executive processor module (XPM); each subsystem has a subordinate processor module (SPM). Both the main system and the various subsystems communicate across the system bus. Within subsystems, communication among modules is across the subsystem's subordinate bus.

The number of modules on the subsystem bus is limited only by electrical characteristics of the bus driver and receiver circuits. The SPM and PCMs on a subsystem can also be accessed via the system bus. A subsystem can operate independently of the main system. All system components can communicate with each other through memory, peripheral controller buffers, and I/O registers that are accessed on the system bus. At the same time, eight subsystems can function independently on the subordinate buses. Since the 8086 generates a 20-bit address that can reference up to a megabyte of memory, a multiprocessing system can have a total of more than 8M bytes of memory.

Address mappings ease communication

Ease of communication among system components is ensured through memory address spaces defined for the various processors. The XPM interfaces only with the system bus and uses only one memory mapping. Each SPM can communicate with the system bus and its own subordinate bus; therefore, each SPM has two different address mappings.

XPM address space is divided into four sections, as shown in Fig 2. Low addresses locate system memory which consists of 64k bytes of XPM onboard RAM and those system memory modules that are attached to the system bus. The second XPM address space section locates dual-port memory in one of the SPMs. With these addresses, the XPM can access 32k bytes of memory belonging to any SPM. A third block of XPM addresses locates memory buffers on PCMs, with 24k bytes reserved for this function. Sizes of buffer memories vary depending on the controller requirements; most buffers are segmented into two sections, enabling a processor to work on one part of the buffer while the controller is filling or emptying another part. The last portion of XPM address space locates read only memory (ROM) used by the XPM to store system bootstrap routines and self-test programs.

Each SPM has control circuits that define two distinct address spaces: one for use with the system bus, and the other for use with the subordinate bus. Some SPM memory shares printed circuit board space with the SPM processor. This onboard RAM and ROM is accessed by the SPM through local bus addresses at ends of the memory spaces and does not depend on active address mapping. Only when the SPM makes an offboard memory reference, using the system bus or subordinate bus, does the address mapping distinction occur. Then the memory request is routed to the appropriate bus, depending on which address mapping is active.

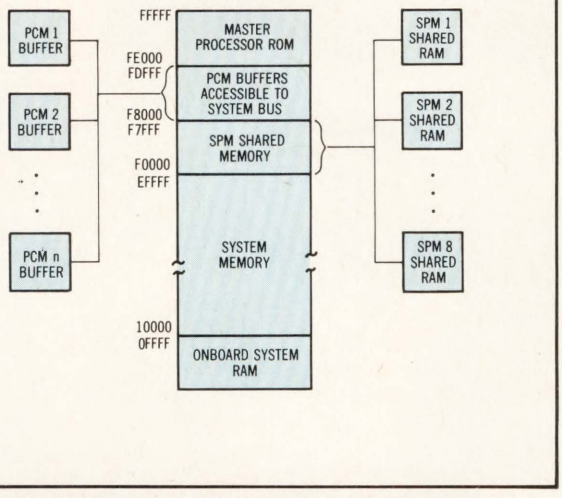


Fig 2 XPM address space. Memory dispersed throughout Fig 1 can be accessed by XPM, which is primary user of system memory. In addition, SPM shared memory space maps half of any one SPM's dual-port memory. Peripheral device buffers and ROM complete XPM memory allocation

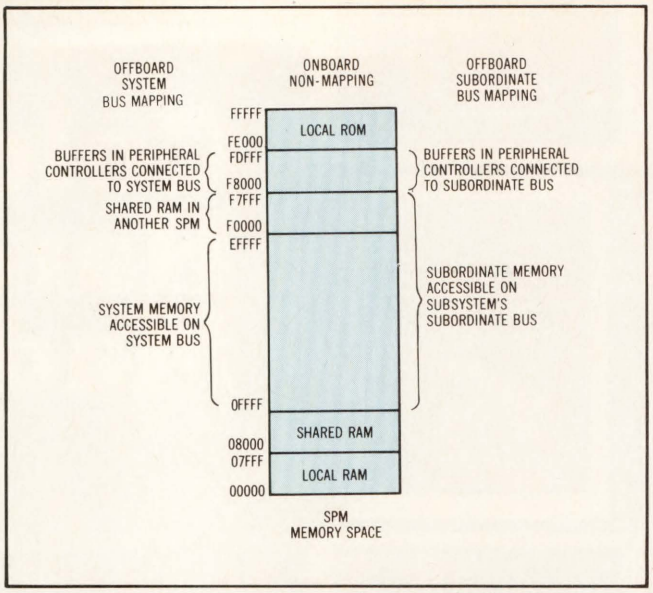


Fig 3 SPM address spaces. SPM circuitry provides two distinct mappings to access distributed memory. Either system bus mapping, at left, or subordinate bus mapping, at right, serves midrange addresses. Ends of address space reference local bus memory and do not depend on mapping



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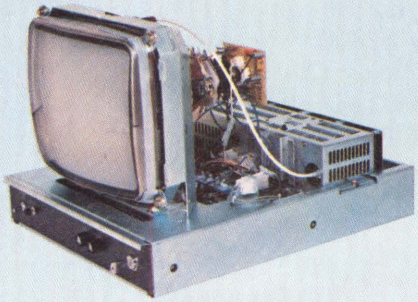
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The offboard system bus mapping divides SPM memory into three regions (Fig 3). The section above the onboard RAM locates the system memory accessible through the system bus. The next section locates the 32k-bytes shared memory of another SPM. The final section locates PCM buffer memories that connect to the system bus. A peripheral controller can connect to either the system bus or a subordinate bus, and processor I/O operations can change the bus connection; however, the controller is connected to only one bus at any given time.

The SPM address mapping for its subordinate bus also appears in Fig 3. High and low addresses, which do not depend on the mapping, are defined as before. Subordinate memory, accessible via the subordinate bus, accounts for a block of midrange addresses; buffers within peripheral controllers that are attached to the subordinate bus have relatively high addresses. If a controller connects to both the system bus and the subordinate bus, its associated addresses cannot be shared by another controller. If it connects to only one bus, however, another controller can use its addresses on the other bus.

Summary

A powerful and flexible multiprocessing system uses only one kind of microprocessor as a common intelligent element to offer faster response with greater throughput. Unusual design features overcome some of the drawbacks that limit other multiprocessing architectures. A hierarchy of buses allows communication among the master processor, the subordinate processors, and local modules within a subordinate processor. A flexible set of address mappings allows processors to access memory that is dispersed throughout the multiprocessing system. Subordinate processors have two distinct address mappings to make different memory regions available on the various buses. The result is a high performance architecture that is easily customized for a variety of applications.

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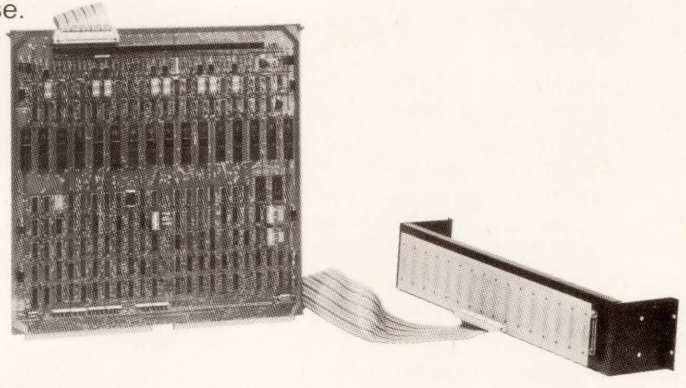
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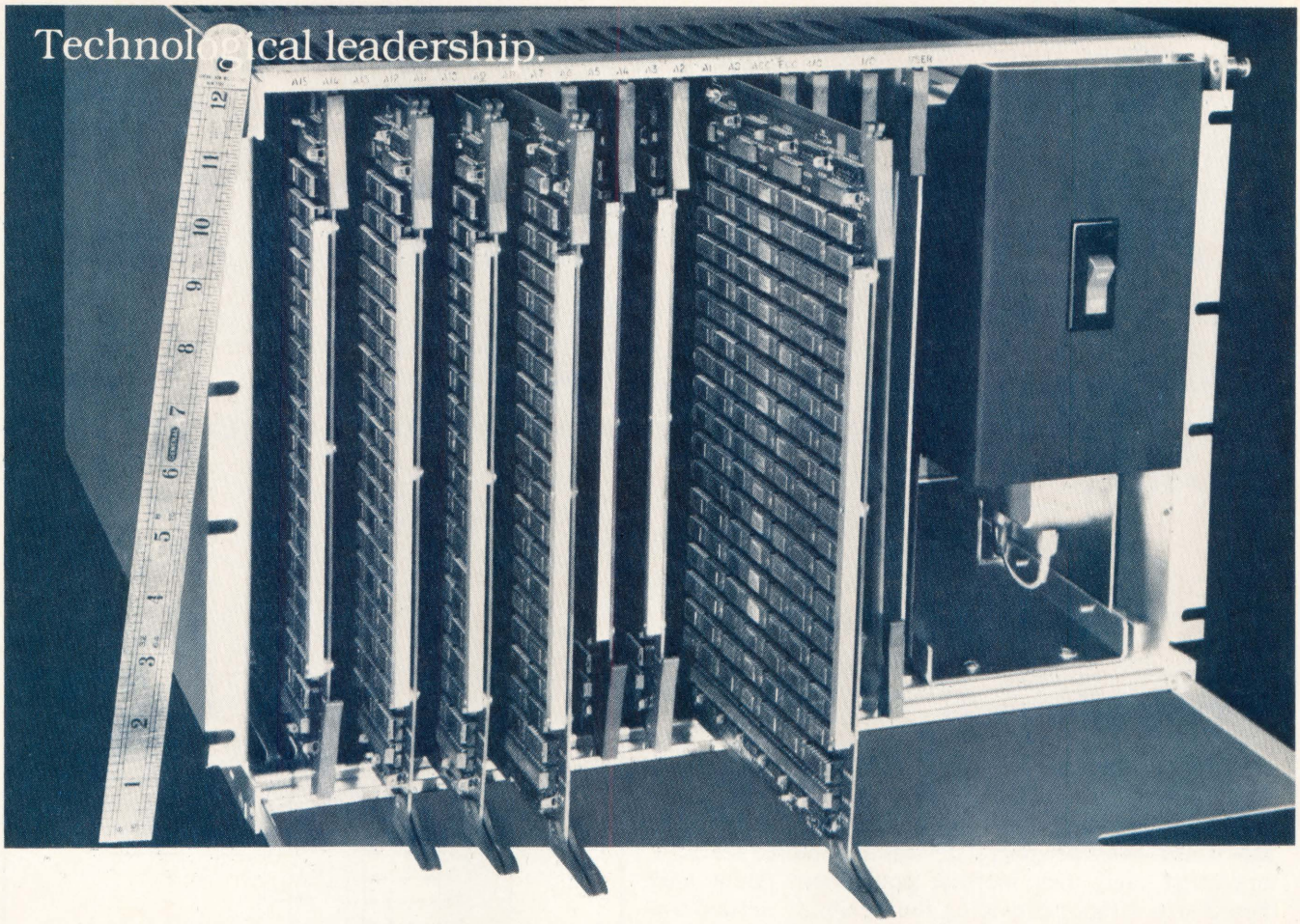
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4-BIT MICRO ADAPTS TO 8-BIT WORLD

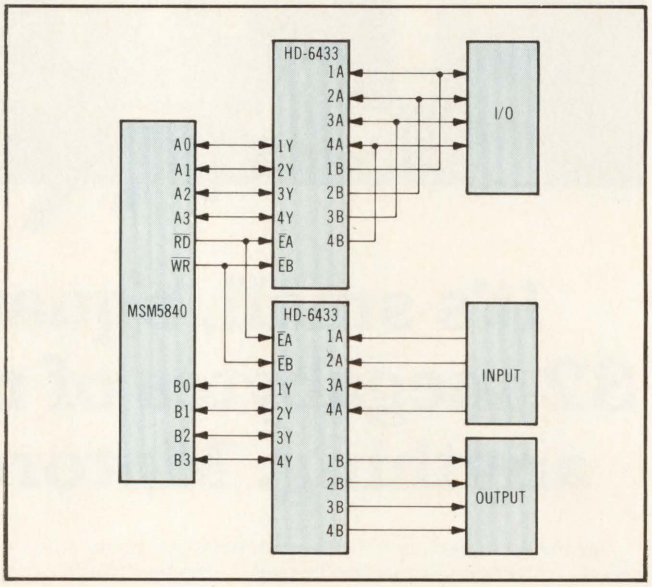
An I/O expansion technique customizes a 4-bit device for 8-bit operation

by Walter J. Niewierski

Data bus and input/output interfacing for 4-bit microcomputers can be a problem in an 8-bit world. Most peripheral devices are tailored for 8-bit operation, and they increase component count and board size without providing the flexibility needed for efficient 4-bit design.

In 4-bit microcomputers with associated read/write control outputs for data and input/output (I/O) transfers, data movement through the bus interface device is automatically controlled by the processor. In the Figure, the OKI MSM5840 single-chip 4-bit microcomputer interfaces directly to the Harris complementary metal oxide semiconductor quad bus separator, the HD-6433. The $\overline{RD}$ and $\overline{WR}$ control signals are active low whenever a data transfer is being executed at port A or port B. The separate 4-bit bidirectional bus format of this microprocessor allows interface to two I/O ports on these lines. The interface of separate input and output lines to these bidirectional buses is achieved through the split A and B lines on the HD-6433. If bidirectional to bidirectional interface is needed on the 4-bit buses, it is accomplished by connecting the A inputs to their respective B outputs. This allows the HD-6433 to act as a quad bidirectional bus transceiver. The two 4-bit bidirectional buses on the MSM5840 allow the mixing of split and bidirectional I/O to the microcomputer.

Walter Niewierski is a senior engineer in the CMOS Applications Group at Harris Semiconductor, PO Box 883, MS 54-045, Melbourne, FL 32905, where his responsibilities include microprocessor and peripheral device support. He received a BSEE degree from the University of Michigan, where he began graduate work before moving to Florida. His previous work experience includes the design of microprocessor based test equipment at Ford Motor Company.



A similar technique can be used in microcomputers that do not have $\overline{RD}$ and $\overline{WR}$ signals. In these systems, the control signals are generated through one or two bits of a dedicated output port. These hardware outputs, coupled with appropriate software bit manipulation routines, provide the needed control signals for I/O interface.

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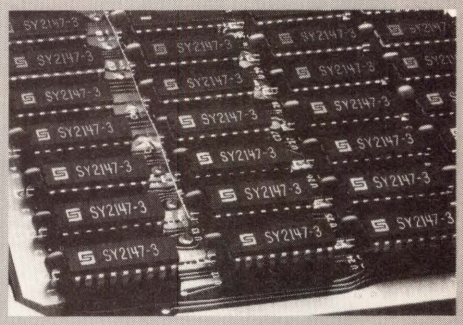
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	SY2147	70nsec	160mA	20mA
	SY2147-6	85nsec	160mA	20mA
1Kx4	SY2148H-2	45nsec	150mA	30mA
	SY2148H-3	55nsec	150mA	30mA
	SY2148HL-3	55nsec	125mA	20mA
	SY2148H	70nsec	150mA	30mA
	SY2148HL	70nsec	125mA	20mA
1Kx4	SY2149H-2	45nsec	150mA	*
	SY2149H-3	55nsec	150mA	*
	SY2149HL-3	55nsec	125mA	*
	SY2149H	70nsec	150mA	*
	SY2149HL	70nsec	125mA	*

*Not Applicable

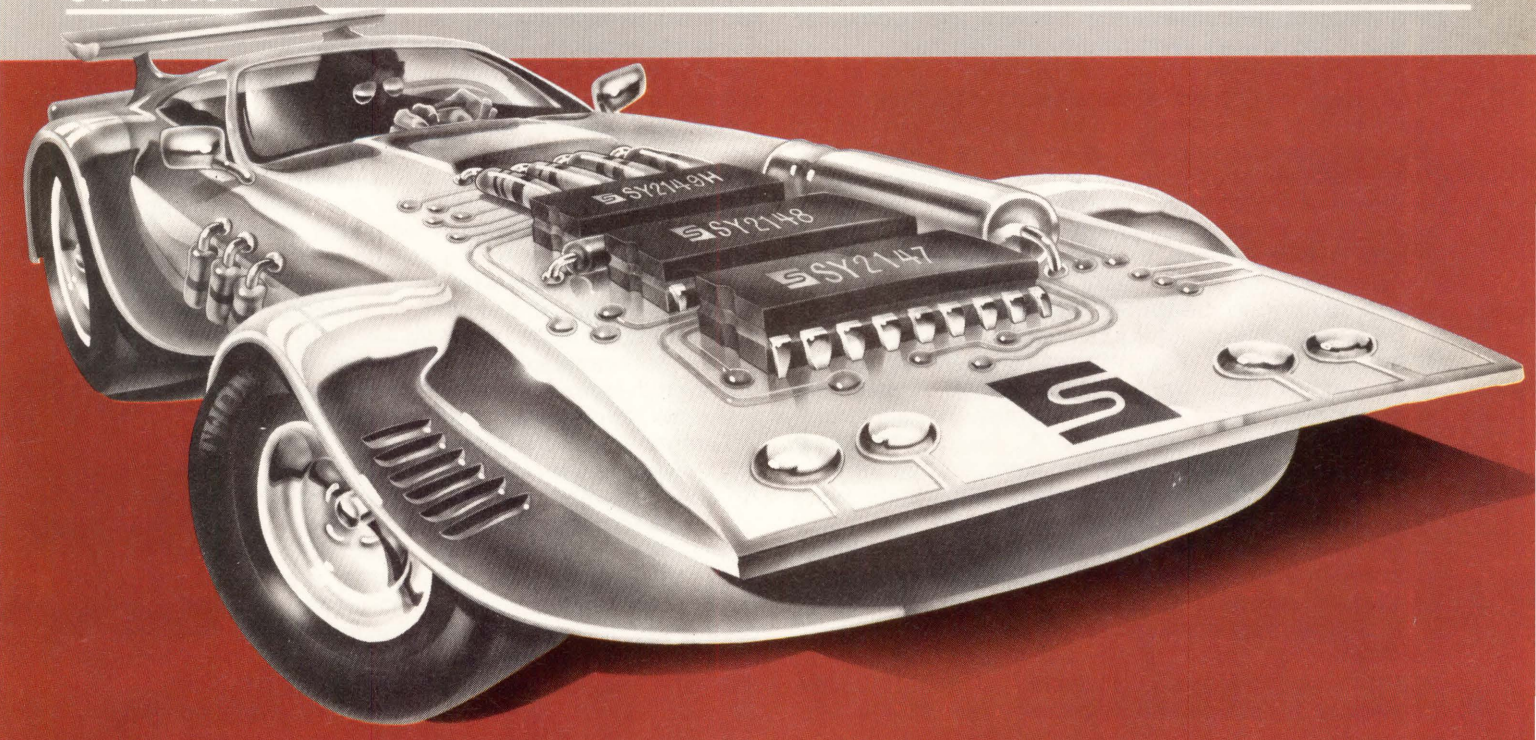
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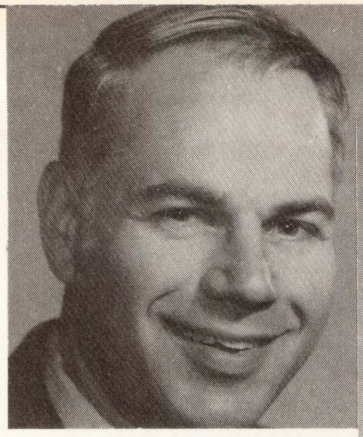
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SY2148H 45nsec
SY2149H 45nsec



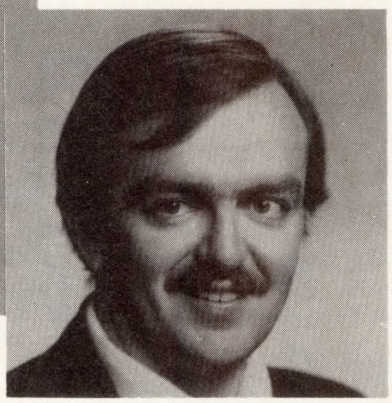
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IECI '81

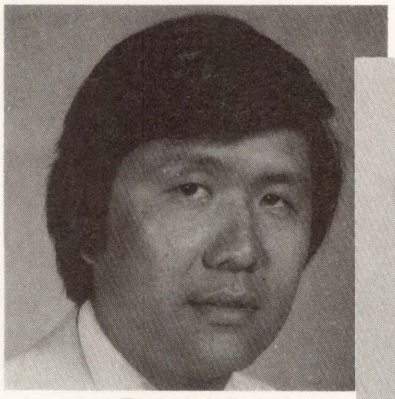
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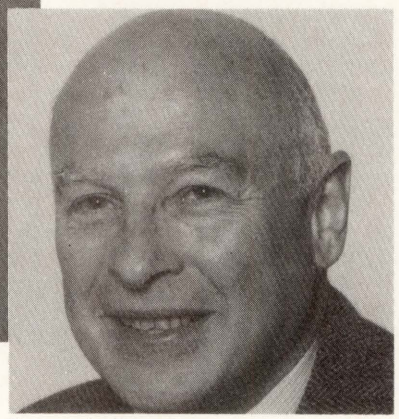
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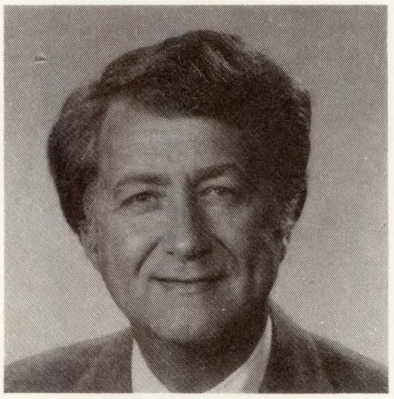
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Robert A. Begun



Keynote Speaker
Donald K. Grierson

For the first time in its seven years of existence, IECI will be held in San Francisco. Before this, the annual conference on the applications of mini- and microcomputers, cosponsored by the IEEE's Industrial Electronics and Control Instrumentation Society and Computer Society, had always been held in Philadelphia.

All IECI '81 technical program sessions will be at the Hyatt Regency San Francisco, Embarcadero Center. The many papers to be presented by speakers from foreign corporations and universities—more than half of the total—indicate that this will truly be an international conference. Countries to be represented include Japan, India, Italy, Finland, Korea, France, Belgium, England, Australia, New Zealand, the People's Republic of China, Taiwan, Portugal, Saudi Arabia, Turkey, Egypt, and Mexico, in addition to the United States and Canada.

General cochairmen for IECI '81 are J. David Irwin, professor and head of the electrical engineering department, and H. Troy Nagle, Jr, professor of electrical engineering, both at Auburn University. Technical program cochairmen are Robert A. Begun, technical manager of subcontracts for FMC Corp, and Victor K. L. Huang, supervisor of the microprocessor peripherals device group at Bell Telephone Laboratories. Keynote speaker will be Donald K. Grierson, senior vice president and group executive of General Electric's industrial electronics business group.

Technical program sessions will be held from 8:30 am to 4:30 pm on Tuesday, November 10, and from 9 am to 4:30 pm on Wednesday, November 11 and Thursday, November 12. In addition, two concurrent special sessions will be presented from 7 to 10 pm on Wednesday. One, vendor oriented, will be about 8-bit microcomputer families for control in the '80s, and will include representatives from American Microsystems, Intel, Motorola Semiconductor, National Semiconductor, and Texas Instruments. The second, a tutorial overview, will cover applications of local computer networking in the industrial control environment.

Special tutorials will be offered again this year. Tutorial I, "Data Acquisition System Technology," with Richard C. Jaeger of Auburn University as instructor, will be held on the day preceding the regular sessions, from 9 am to 5 pm Monday, November 9. This course will be conducted at the undergraduate level for engineers, scientists, and others who have a basic understanding of electronics and some knowledge of micro- or minicomputers. Its objective will be to provide a foundation for understanding the characteristics of data acquisition system components and to assist in selecting instrumentation from current hardware offerings.

Tutorial II, 9 am to 5 pm on Friday, November 13, the day following the conference, will be conducted by Alfred C. Weaver of the University of Virginia. Its subject will be "Microprocessor Applications in Industrial Process Control." Attendees are expected to be scientists and engineers familiar with digital electronics, who want to use microprocessors to control physical processes and devices. The course is intended to illustrate uses of the digital hardware, software, and algorithms that form intelligent control systems.

(continued on page 190)

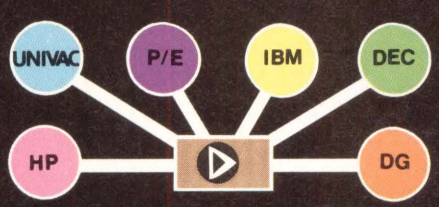


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Registration

At-door Conference registration fees are $90 for IEEE members, $110 for nonmembers, and $50 for students. Each registrant will receive one copy of the *Conference Proceedings;* extra copies will be available during the Conference for $25. For further information or to obtain Conference registration forms, contact LeRoy Bushart, ESD Corp, 328 Brokaw Rd, Santa Clara, CA 95050 (tel: 408/289-3871).

Tutorial registration fees are $90 for either tutorial or $150 for both. Information on Tutorial I is available from Professor Jaeger at 205/826-4330 and for Tutorial II from Professor Weaver at 804/924-7201.

Technical program

Session 1 — Automated System Controls

Tuesday **8:30 to 11 am** **San Francisco A**

Chairman: R. C. Born, Eaton Corp

1/1 "An Application of a Minicomputer to a Computer NC System of a Machine Tool"
T. Watanabe and S. Iwai, Kyoto Univ

1/2 "Adaptive Digital Control of High Speed Rotating Mirror Cameras"
A. N. Payne, Lawrence Livermore National Laboratories

1/3 "An Electronic Nameplate Prototype"
H. M. Collins and J. C. Tavora, Univ of Houston

1/4 "Multiple Micro for Process Control and Monitoring"
R. H. Leaf, Microprocessor Laboratories

1/5 "Microcomputer Application to a Paper Loading Machine"
J. Ishikawa, Toshiba Corp

Session 2 — Power Converters

Tuesday **8:30 to 11 am** **Golden Gate A**

Chairman: F. Harashima, Univ of Tokyo

2/1 "Microprocessor Control of Subdivided Interval Controlled Cycloconverters"
H. Ichida, H. Okamoto, and A. Miyazaki, Kyoto Institute of Technology

2/2 "Microcomputer Based Symmetrical Sinusoidal Pulse Width Modulated Inverter"
K. Rajashekara and J. Vithayathil, Indian Institute of Science

2/3 "Microprocessor Controlled Single-Phase to Single-Phase Cycloconverter"
S. Bas and O. Kaynak, Bogazici Univ

2/4 "Realization on a Microcomputer of an Inverter Control Device for High Power Induction Motor Drives"
A. Bellini, C. Del Mastro, G. Figalli, and G. Ulivi, Univ di Roma

2/5 "A Flexible Controller for Current Regulated PWM Inverter"
V. Stefanovic, C. Pepalpannou, and P. Palaniappan, Univ of Missouri-Columbia

Session 3 — Biomedical

Tuesday **8:30 to 11 am** **Golden Gate B**

Chairman: I. Thomae, Dartmouth College

3/1 "A Microprocessor Based, Realtime Monitoring System for the Neurosurgical Intensive Care Unit"
M. See, R. Sclabassi, and J. Vries, Univ of Pittsburgh

3/2 "Artificial Heart Blood Pump Motor Controller"
J. Bernitt and W. Lord, North American Philips Corp

3/3 "Dual-Microprocessor System for Biomedical Data Acquisition and Processing"
A. Menard, M. Goldberg, A. Smith, and S. Stuchly, Univ of Ottawa

3/4 "Modeling of Wheelchair Dynamics for the Design of a Microcomputer Based Controller"
B. Johnson and J. Aylor, Univ of Virginia

3/5 "A Microcomputer Based Multichannel Functional Neuromuscular Stimulation Unit"
A. Cohen and D. Orin, The Ohio State Univ

Keynote address — 11 am to 12 noon

Session 4 — Software Techniques

Tuesday **2 to 4:30 pm** **San Francisco A**

Chairman: A. Delfino, Software Engineering and Instruction Inc

4/1 "Integration of Multiple-Guidance System Test into One-Guidance System Program"
E. Smally, C. S. Draper Laboratory

4/2 "A Software Design Tool for Multi-Microprocessor Systems"
L. Patnaik, A. Venkatesan, and D. Jayasimna, Indian Institute of Science

4/3 "An Optimal Resource Scheduler for Multitasking Realtime I/O Bound Processes"
A. Kuri, Micromex, S.A.

4/4 "An Integrated Data Acquisition, Processing, and Display System for Unstable Combustion Experiments"
E. Cernu, O. Hughes, and B. Sauvageau, Univ de Montreal

4/5 "Considerations for the Design of Software for Microprocessor Systems"
R. Gottlieb, General Electric Co

Session 5 — Data Acquisition

Tuesday **2 to 4:30 pm** **Golden Gate A**

Chairman: W. E. Bennett, Virginia Polytechnic Institute and State Univ

5/1 "Microprocessor Based Data Acquisition System"
B. Colburn, Texas A & M Univ

5/2 "A Microcomputer Based Data Acquisition and Control System for an Electron Spectrometer"
M. Tervonen, Technical Research Center of Finland

5/3 "Residential Photovoltaic Experiment Station Data System"
H. Fenton and C. Much, Massachusetts Institute of Technology

5/4 "A Multiple-Microcomputer Data Acquisition Subsystem for a Power Control Center"
T. Hoats, R. Serafin, and D. Woods, Pennsylvania Power & Light Co

5/5 "Measurement of Probability Density Functions Using a 16-Bit Microcomputer"
A. Sarkady, L. Ingeneri, and R. Medley, U.S. Naval Academy

Session 6 Automatic Testing and Inspection I

Tuesday **2 to 4:30 pm** **Golden Gate B**

Chairman: T. Hasegawa, Toshiba Corp

6/1 "A Man-Machine Interactive Microcomputer System for Diagnosis of Engine Trouble by Fuzzy Logic"
C. Wu and W. Shu, Tsinghua Univ

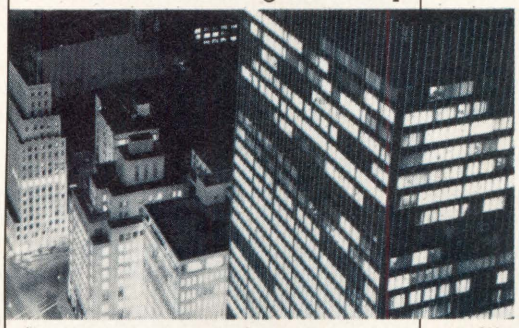
6/2 "A Microcomputer Based Test System for Charge-Coupled Devices"
S. Sidman, Lawrence Berkeley Laboratory

6/3 "Methods of Realtime Non Data-Destructive RAM Self-Tests"
D. Schowengerdt and D. Lenhert, Kansas State Univ

(continued on page 192)

When the Canadian Government needed a totally secure local data distribution network, they ordered our Fiber Optic System.

The data distribution Problem: The Canadian Government made their problem completely clear. One of their agencies was expanding its headquarters into several floors of an adjacent office building and they insisted upon installing a secure local data distribution network to carry "sensitive" traffic. Minimal start-up costs and future expandability were further considerations.



The Fiber Optic Solution: Versitron's System Design Group studied the problem and recommended a fiber optic network utilizing advanced fiber optic modems. This recommendation assured total traffic security throughout the network. Not only because of fiber optic's inherent physical protection, but also through a unique intrusion alarm feature that immediately shuts down any data link where the integrity is suspect. The start-up cost for this system proved to be highly competitive with an equivalent coaxial system. Plus, the fiber optic system's capacity could be expanded by a factor of fifteen by merely replacing the single channel modem with Versitron's 15 channel multiplexer system.



The Final Outcome: The Canadian Government was impressed. They ordered the fiber optic system and, in one stroke, met all of their requirements for security, cost, and expandability.

The lesson learned here is applicable to a large range of data distribution situations. Let Versitron's System Design Group assist you on your next project. Call us at (202) 882-8464. Or write to: 6310 Chillum Place N.W., Washington, D.C. 20011.

VERSITRON, INC.

CIRCLE 108 ON INQUIRY CARD

6/4 "Automatic Link Monitoring"
S. Glixon, Ford Aerospace and Communications Corp

6/5 "Self-Diagnostic Capability for a Simplex Processor"
S. Davison, F. Goetz, and J. Tam, Bell Telephone Laboratories

Wednesday

Session 7 Automated Manufacturing and NC

Wednesday **9 am to 12 noon** **San Francisco A**

Chairman: D. Dornfeld, Univ of California at Berkeley

7/1 "A Microprocessor Based NC System"
Da-yi Li, Tsinghua Univ

7/2 "The Direct Data Input CNC with an Interactive CRT Display"
M. Oshima and E. Ohno, Mitsubishi Electric Corp

7/3 "A General Purpose Microcomputer Retrofittable Milling Machine Controller"
D. Cheng and J. Sue Chang, Sue Engineering

7/4 "Minicomputer Control of Large Scale Order Picking System"
L. Bushart and L. Hennessy, Engineered Systems Development Corp

7/5 "Case History: Development of a Large Scale Minicomputer Based Digital Control System"
D. Allen and A. Howard, International Computing Co

7/6 "Computer Aids for an Electrical Manufacturing Business"
V. Verheyden, General Electric Co

Session 8 Automotive Control & Diagnostics

Wednesday **9 to 11:30 am** **Golden Gate A**

Chairman: V. Nelson, Univ of Auburn

8/1 "A Digital Control and Monitor System for Propulsion of Battery Electric Vehicles"
H. C. Wang and J. C. Liao, National Tsing Hua Univ

8/2 "A Microcomputer Based Propulsion System of a Hybrid Electric Vehicle"
B. Bose, C. Somuah, and H. Sutherland, General Electric Co

8/3 "A Microprocessor Based Automatic Test Equipment for a Thyristor Chopper of an Electric Car"
M. Ohara, Fuji Electric Co Ltd

8/4 "Intelligent Engine Analyzer"
A. Chang and D. Schweigler, FMC Corp

Session 9 Power Systems

Wednesday **9 to 11:30 am** **Golden Gate B**

Chairman: F. Stich, Siemens-Allis

9/1 "Cost Savings with an Advanced Control System for Electrostatic Precipitators"
G. Ben-Yaacov, Gibbs & Hill Inc

9/2 "Two-Level Load-Frequency Control of Interconnected Power Systems"
G. Aly and Y. Abdel-Magid, Univ of Petroleum & Minerals

9/3 "Optimal and Noninteracted Controller for the Megawatt Frequency Control Problem"
I. Abd El-Salam and I. Awad, Alexandria Univ

9/4 "Investigation into the Effectiveness of Digital Controllers in Power Systems"
A. Alli, A. Faraq, and S. Selim, Univ of Petroleum & Minerals

9/5 "A System Approach to Time of Use Metering"
P. Johnston and R. Medlin, Westinghouse Electric Corp

Session 10 Motor Control I

Wednesday **2 to 4:30 pm** **San Francisco A**

Chairman: V. Stefanovic, General Electric Co

10/1 "Microcomputer Controlled VSCF System"
M. Nasser and M. Bishay, MTC College

10/2 "A Microcomputer Algorithm Applied for Servomotor Control Feedback Loop System Studies"
Chun Ying Yu, Bechtel Power Corp

10/3 "A Microcomputer Based Thyristor Leonard System"
T. Hasegawa, T. Nakagawa, H. Hosoda, and R. Kurosawa, Toshiba Corp

10/4 "Microprocessor Based Optimal Speed Control System of Motor Drives"
F. Harashima and S. Kondo, Univ of Tokyo

10/5 "Microprocessor Controlled Multimotor dc Drive System"
S. Palanichamy and K. Purushothaman, PSG College of Technology

Session 11 Signal Processing

Wednesday **2 to 4:30 pm** **Golden Gate A**

Chairman: A. Sarkady, U.S. Naval Academy

11/1 "A Color Picture Processing System Using a 16-Bit Microprocessor"
Y. Okawa, Gifu Univ

11/2 "Minis and Micros in Image Processing"
W. Bryant, Ford Aerospace and Communications Corp

11/3 "A Microcomputer Based Instrument for the Analysis and Interpretation of Geophysical Data in Opencast Mining"
J. Hill, R. Young, and D. Gabell, Univ of Hull

11/4 "Realtime Voice Encryption Using a Microcomputer"
P. Velga and J. Delgado, Instituto Superior Technico

11/5 "Signal Processor Based Controller for Suboscillation PWM Inverters"
G. Buja and P. DeNardi, Univ di Padova

Session 12 Automatic Testing and Inspection II

Wednesday **2 to 4:30 pm** **Golden Gate B**

Chairman: C. Einolf, Jr, Westinghouse Electric Corp

12/1 "Flexible Logic and Analog Tester Controlled by Microprocessor"
A. Nakayama, N. Hashimoto, M. Shimada, and H. Sugiyama, Nippon Electric Co

12/2 "Use of Embedded Microcomputers in System Debugging and Maintenance"
J. Meng, Lawrence Berkeley Laboratory

12/3 "Microprocessor Based IC Tester"
R. Hariharan and H. Srinivas, Indian Institute of Science

12/4 "Personal Computer Based ROM Evaluation System for Failure Pattern Recognition"
C. Yang, C. Winterble, and R. Olah, Commodore/MOS Technology Inc

12/5 "A Microcomputer Controlled Inspecting and Monitoring System for Induction Motor"
C. Chang, S. Lin, L. Tseng, and Y. Lee, National Cheng Kung Univ

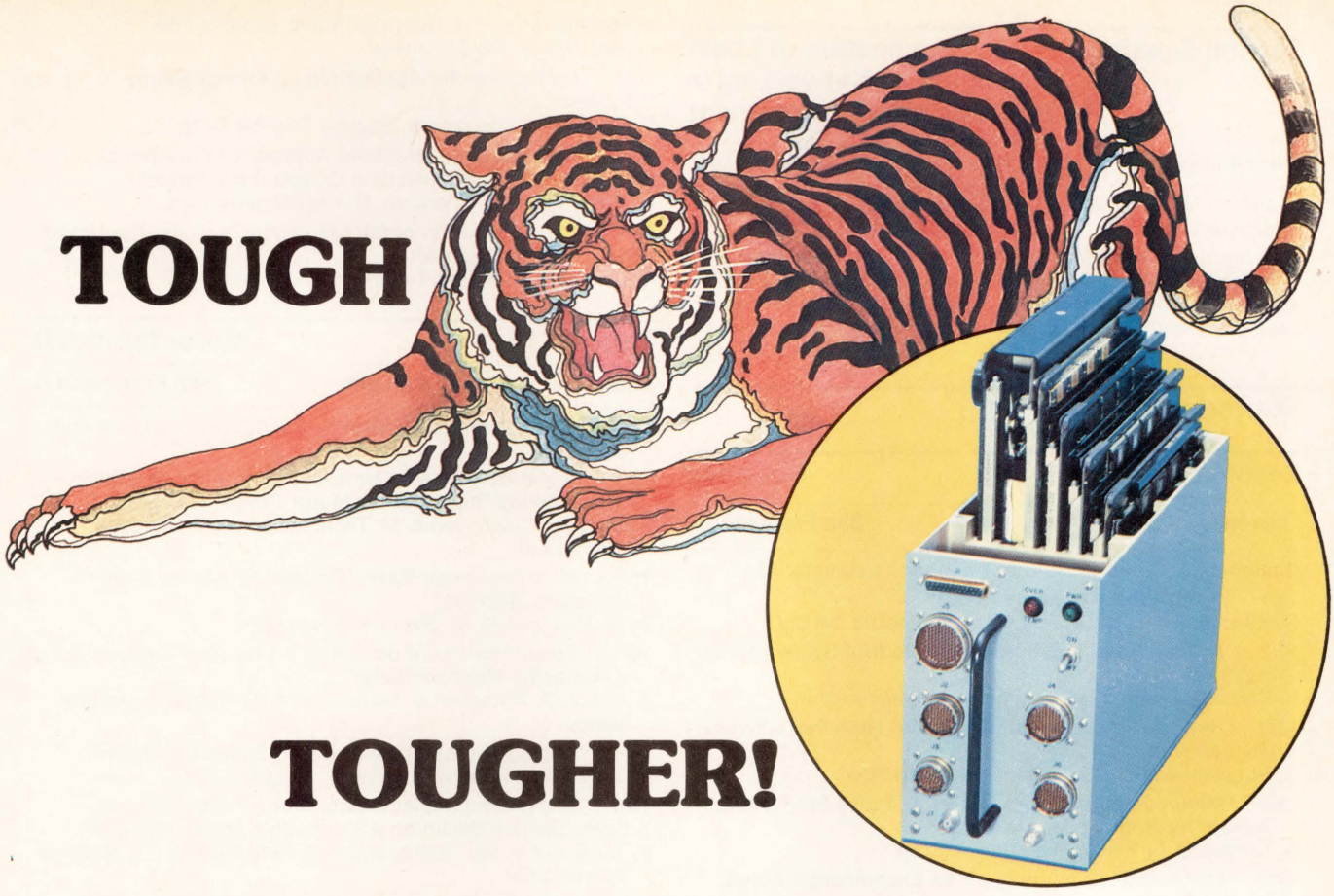
Special Vendor Session "Eight-Bit Microcomputer Families for Control in the Eighties"

Wednesday **7 to 10 pm** **Golden Gate A**

Chairman: R. C. Born, Eaton Corp

Representatives of five microcomputer manufacturers will discuss their products.

(continued on page 194)



SECS 80: A complete family of systems designed around EMM's ruggedized versions of Intel's Single Board Computers

Meets MIL Specs. Flexible, Too
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CIRCLE 109 ON INQUIRY CARD

Special Session — Application of Local Computer Networking in Industrial Control Environment

Wednesday **7 to 10 pm** **Golden Gate B**

Chairmen: J. Q. Torode and R. Bettenhausen, Digital Microsystems Inc

This tutorial session will establish the conditions under which industrial control systems must operate, and then present ways in which local computer networking schemes can meet the requirements for such systems.

Thursday

Session 13 — Robotics

Thursday **9 to 11:30 am** **San Francisco A**

Chairman: J. C. Harsbaw, Bell Telephone Laboratories

13/1 "A Universal Assembly Robot"
G. Kimoto and S. Katayama, Nippon Electric Co Ltd

13/2 "A Distributed Microprocessor Control System for an Industrial Robot"
R. Rafauli, N. Sinha, and J. Tlusty, McMaster Univ

13/3 "Hybrid Techniques for Control of High Performance Mechanisms"
C. Ringwall and L. Clark, General Electric Co

13/4 "Microcomputer Control of an Adaptive Positioning System for Robotic Arc Welding"
G. Cook and A. Wells, The Merrick Corp

13/5 "Distributed Computing on an Experimental Robot Control System"
M. Kuo, Univ of Wisconsin-Parkside

Session 14 — Transducers, Sensors and Interface

Thursday **9 to 11:30 am** **Golden Gate A**

Chairman: J. Mallon, Jr, Kulite Semiconductor Products, Inc

14/1 "On Integration of TM990/189 and IMSAI 8080 Microcomputer Systems"
W. Lin and M. Jing, Univ of California at Davis

14/2 "A New Transducer for Automatic Angle Measurement"
T. Vu, Univ of New South Wales

14/3 "The Man-Machine Interface in Dedicated Computer Controller Applications"
V. Jones, Hewlett-Packard Co

14/4 "An Aid for the Teaching of the Programming of Multi-Microcomputer Controlled Systems"
A. Payne, Univ of Waikato

14/5 "A New Concept in Data Highway Technology for Control Applications"
J. Leidy, AMP Inc

Session 15 — Energy Systems

Thursday **9 to 11:30 am** **Golden Gate B**

Chairman: B. K. Bose, General Electric Co

15/1 "Microcomputer Based Data Acquisition and Processing System; Application in Commissioning of a Geothermal Flashing Plant"
A. Rothhirsch and J. Gonzalez Rubio, Instituto de Investigaciones Electricas

15/2 "Microcomputer Application on Energy Saving System"
T. Fujita, Y. Wada, and K. Suzuki, Toshiba Corp

15/3 "A Microcomputer Based Approach to Control of Multimegawatt Photovoltaic Concentrator System"
R. Semma and M. Imamura, Martin Marietta Corp

15/4 "The Application of Microprocessors to the Control of Gas Turbine Engines"
E. Orhun, Middle East Technical Univ

Session 16 — Motor Control II

Thursday **2 to 4:30 pm** **San Francisco A**

Chairman: N. Demersash, Virginia Polytechnic Institute and State Univ

16/1 "A Microprocessor Controlled High Accuracy Wide Range Speed Regulator for Motor Drives"
T. Ohmae, K. Kamiyama, M. Tachikawa, and T. Matsuda, Hitachi Ltd

16/2 "Microprocessor Based Optimal Efficiency Drive of Induction Machine"
M. H. Park and S. Ki, Seoul National Univ

16/3 "Speed Control of dc Motor: A Low Cost System Using a Monochip Microcomputer"
J. Aubry, G. Pfitscher, J. Louis, and A. El-Hefnawy, Univ de Nancy

16/4 "Analog Microprocessor Based Speed Controller"
V. Jaswa and T. Zaloum, General Electric Co

16/5 "Design and Implementation of a Fully Digital dc Servo System Based on a Single-Chip Microcomputer"
P. Tang and Y. Wu, National Chiao Tung Univ; S. Lu, National Taiwan Univ

Session 17 — Process Control

Thursday **2 to 4:30 pm** **Golden Gate A**

Chairman: E. Colburn, Texas A&M Univ

17/1 "Pattern Generators for Hybrid ICs"
G. Kimoto, K. Morimoto, K. Miyazaki, and K. Nakumura, Nippon Electric Co

17/2 "Microcomputer Software and Hardware Design Techniques for Industrial Logic Controller Using Mixed Events"
O. Yenersoy, Univ Libre de Bruxelles

17/3 "Applications of Minicomputers to Multi-Variable Control Systems"
C. Herget, Lawrence Livermore National Laboratories

17/4 "A Chemical and Process Recipe Input Distributed Control System"
M. Agulner, R. Collins, and B. Ross, Polaroid Corp

17/5 "A Closed Loop Auto-Tuning Method for Digital PID Controller"
T. Shigemasa and K. Akizuki, Toshiba Corp

Session 18 — Machine Vision

Thursday **2 to 4:30 pm** **Golden Gate B**

Chairman: A. Goksel, Bell Telephone Laboratories

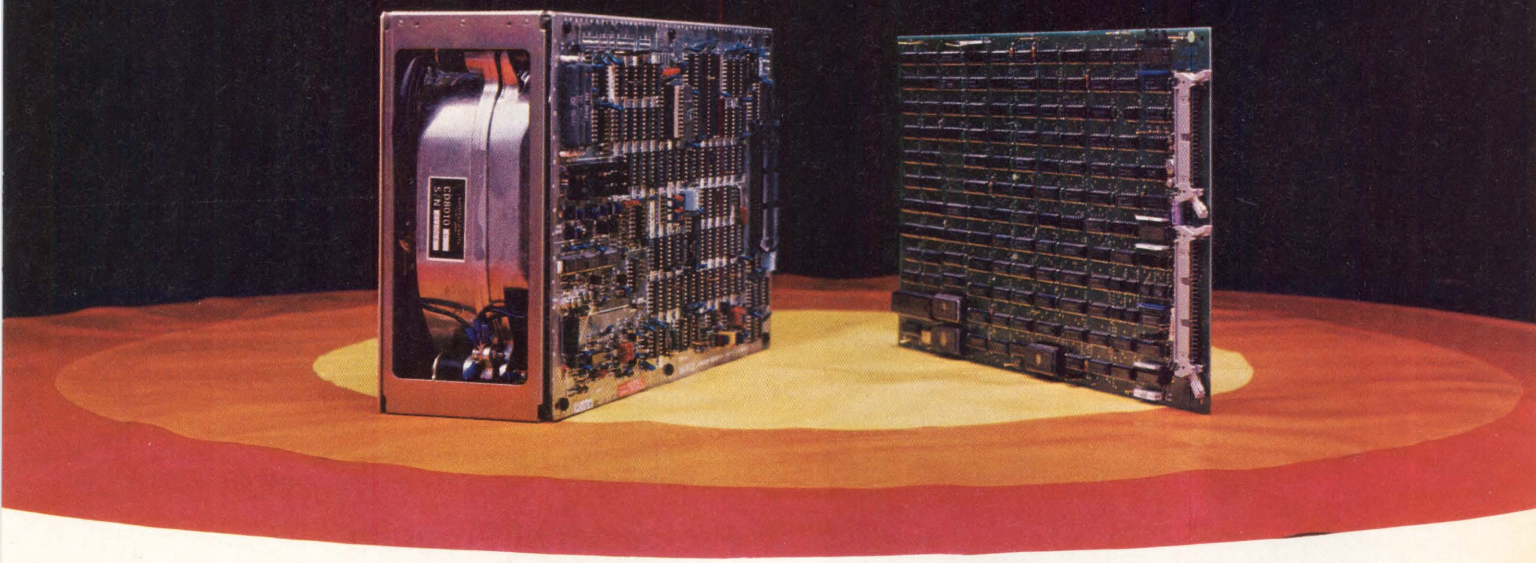
18/1 "An Automatic Picture Adjusting System for Color Picture Tube"
I. Kawaguchi, Hitachi Ltd

18/2 "Microcomputer Controlled Potato Sizing and Selecting Machinery"
P. McCrea, Univ of Essex

18/3 "Silhouette Area and Centroid Measurement Using a CID Camera and an 8086 Microcomputer"
D. Capson and R. Kitai, McMaster Univ

18/4 "Optomation II Microprocessor Based Vision Processing Instrumentation for Automatic Inspection"
J. Lunden, General Electric Co

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11 megabytes for only $1395

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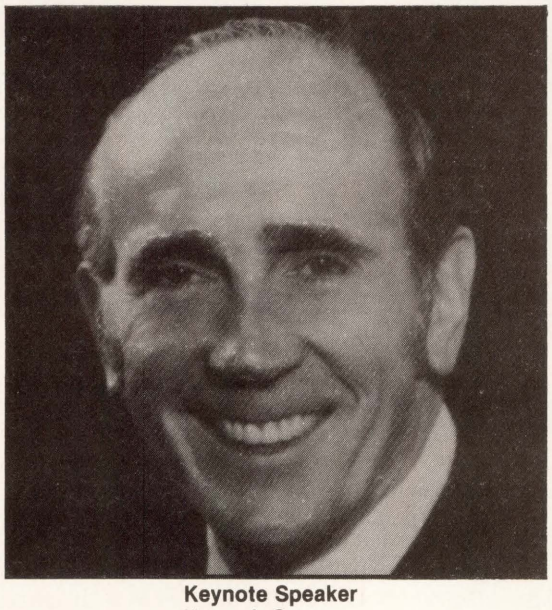
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CIRCLE 110 ON INQUIRY CARD

Midcon/81

Electronic Show & Convention
November 10 – 12, 1981
O'Hare Exposition Center
Chicago



Keynote Speaker
Harry J. Gray

IEEE's annual mid-West electronic show and convention —Midcon—will again emphasize the technological interests of that area's industrial markets and of the engineering personnel who work there. Midcon/81 will be held in the Exposition Center and adjacent Hyatt Regency Hotel at Chicago's O'Hare International Airport in suburban Rosemont. Nearly 120 technical papers will be presented in 24 professional program sessions, all at the Hyatt Regency Hotel. At the Exposition Center, 400 electronic subsystem and component manufacturers, as well as associated companies, will display their products in more than 735 exhibit booths. A special exhibit in Hall B will contain a concentration of small computers of interest to the electronics professional.

The Keynote Breakfast, at 7:30 am on Tuesday, November 10, will be the first Midcon/81 event. It will be held at the Hyatt Regency Hotel with Harry J. Gray, chairman and president of United Technologies Corp, as Keynote Speaker.

All professional program sessions will be formatted in three concurrent groups: 9 to 11 am and 12:30 to 2:30 pm on Tuesday; and 9 to 11 am, 12:30 to 2:30 pm, and 3:30 to 5:30 pm on Wednesday and Thursday. Exhibit hours will be 9 am to 6 pm on Tuesday, 9 am to 7 pm on Wednesday, and 9 am to 5 pm on Thursday.

Registration

Four registration procedures are available to attendees: obtain a complimentary registration card from a Midcon/81 exhibitor, get a free registration card from a member of Midcon's Inner Circle or Attendance Committee, complete and mail (with a $5.00 fee) one of the special discount coupons sent to many electronics professionals in the Midcon Preview brochure, or stand in line at Midcon and register for $10. All registrants who mail their cards or coupons before October 20 will receive their credentials in the mail before Midcon; credentials for registrants who mail their cards after that date will be held at the Midcon registration desk.

Professional Program

One-third of the Midcon/81 Professional Program will be directly associated with microprocessors and/or microcomputers. Organized by program chairman James L. Melsa of the University of Notre Dame, eight of the 24 separate sessions will involve some phase of microcomputers. Organized by program chairman cover LSI and VLSI and two will discuss communications. Individual sessions will involve speech recognition, human engineering, database management, and emi shielding.

Both component and board level 16- and 32-bit microprocessor systems will be discussed in Session 18 from 9 to 11 am on Thursday. Representatives of National Semiconductor and Intel will review the 16-bit NS 16000 and the 32-bit iAPX component level systems, respectively. Board level discussions will involve the Intel 8086 family with the Multibus and the Motorola 68000 family with the VERSAbus.

Immediately following lunch on Thursday, two consecutive sessions will be dedicated to single-chip microcomputers: Session 20 on system aspects from 12:30 to 2:30 pm and Session 23 on programming aspects from 3:30 to 5:30 pm. The first of these sessions will involve personnel from Mostek, Motorola, Rockwell International, Texas Instruments, and Zilog, each discussing capabilities and applications for its company's products. Participants in the second session—from Motorola, Rockwell International, Texas Instruments, American Microsystems, and NEC Microcomputers—will consider instruction sets, addressing methods, programming ease, and other software traits as they relate to the diverse architectures of available single-chip microcomputers.

Session 13 on Wednesday afternoon from 3:30 to 5:30 will include reviews by several manufacturers of CMOS microprocessors. Stressed will be the advantages of low power and low cost, and high performance of C-HMOS technology. Earlier that afternoon (12:30 to 2:30), the increasing number of peripheral ICs and new functions will be discussed in Session 12. Session 9 (9 to 11 am)

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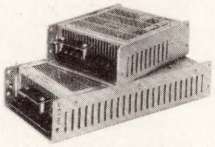
But one thing they all have in common. They're built by Power-One. Which means the most reliable power supplies available, at the lowest cost possible.

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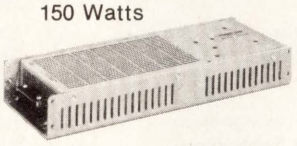


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SK, 200W : $250.00

MULTIPLE OUTPUT

150 Watts



5V @ 20A
12V @ 5A
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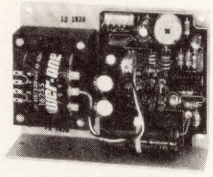
5V @ 10A
± 15V @ 4.5A/16A Peak

SP305 : $345.00

Disk-Drive

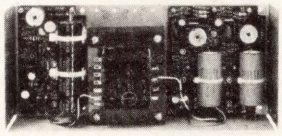
- Powers Most Popular Drives
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CP340, 1 Drive : $44.95
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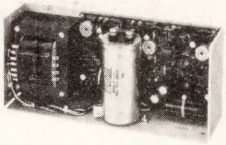
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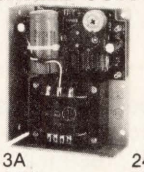


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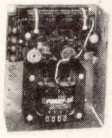
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5V @ 3A
12V @ 1.7A
15V @ 1.5A
24V @ 1.2A
28V @ 1.0A
250V @ 0.1A

HB Series : $24.95

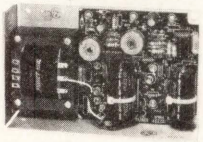
SINGLE OUTPUT



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28V @ 2.0A
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HC Series : $44.95 to $49.95

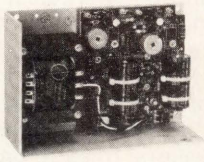
DUAL OUTPUT



± 12V @ 1.0A or
± 15V @ 0.8A

HAA15-0.8 : $39.95

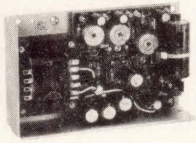
DUAL OUTPUT



± 12V @ 1.7A or
± 15V @ 1.5A

HBB15-1.5 : $49.95

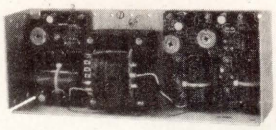
TRIPLE OUTPUT



5V @ 2A
± 9V to ± 15V @ 0.4A

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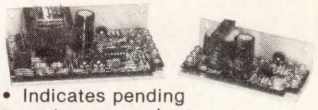
TRIPLE OUTPUT



5V @ 3A
± 12V @ 1A or
± 15V @ 0.8A

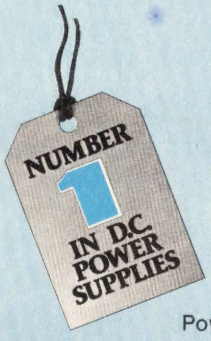
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MIDCON/81 PROFESSIONAL PROGRAM SUMMARY*

		9 to 11 am	
Tues Nov 10	(1) Reduction of Gold Usage on Circuit Boards	(2) The Logic Array Approach to Circuit Design	(3) Personal Computers for Scientific and Industrial Applications
		12:30 to 2:30 pm	
	(4) Vehicle Diagnostics	(5) Computer Aided Design for Custom VLSI	(6) Speech Recognition and Synthesis
		9 to 11 am	
Wed Nov 11	(7) Human Engineering in Electronic Design	(8) Advances in Intelligent Electronic Communication Aids for the Handicapped	(9) Virtual Memory Concepts for 16-Bit Microprocessors and Computers
		12:30 to 2:30 pm	
	(10) State of the Art Techniques in Reliability Engineering	(11) Static Control and Elimination	(12) Microprocessor Peripherals Progress
		3:30 to 5:30 pm	
	(13) CMOS is Now a Micro-Processor Technology	(14) Recent Developments in Per Channel PCM Codec/Filters	(15) Modern Database Management Systems
		9 to 11 am	
Thurs Nov 12	(16) Shielding Techniques and Systems to meet EMI/ESD Requirements in the '80s	(17) Office Automation	(18) Advanced Architectures of 16- and 32-Bit Microprocessor systems
		12:30 to 2:30 pm	
	(19) Telecommunications from the User's Viewpoint	(20) Single-Chip Microcomputers, Part 1—System Aspects	(21) Equity Financing for the Technology Company
		3:30 to 5:30 pm	
	(22) Applications for Semiconductor Memory	(23) Single-Chip Microcomputers, Part 2—Programming Aspects	(24) Microcomputer Bus Structures—What the Future Holds

*Tentative program, subject to change
All sessions in the Hyatt Regency O'Hare Hotel

will deal with the requirement for virtual memory to satisfy the needs of 16-bit microprocessors for large amounts of system memory.

Microcomputer bus structures, including the STD BUS, Multibus/IEEE P796 bus, and IEEE P696 and P896 buses, will be covered in Session 24 on Thursday from 3:30 to 5:30 pm. Emphasis will be on presenting data for the working engineer.

Session 3, on Tuesday morning from 9 to 11, will cover microcomputers from a somewhat different perspective: the use of personal computers for scientific and industrial applications. Speakers will be from Commodore Business Machines, Data Acquisition Systems, Hayes Microcomputer Products, the University of Nebraska, and Advanced Business Communications.

Related closely to the many microprocessor papers will be three sessions on LSI and VLSI. On Tuesday, Session 2, from 9 to 11 am, will review logic array design, particularly as it relates to CAD and the software tools now available; Session 5, from 12:30 to 2:30 pm, will discuss the advantages of CAD for reducing design time for custom VLSI such as PLAs and gate arrays. Also, on Thursday afternoon from 3:30 to 5:30, the applications of LSI and VLSI semiconductor memory, as well as the impact of the technologies on memory system design, will be covered in Session 22.

Communications aspects will be included Wednesday from 3:30 to 5:30 pm in Session 14, a discussion of recent developments in per channel codecs and filters. A second session—19, on Thursday from 12:30 to 2:30 pm—will present a broad perspective on data communications, including OEM, manufacturer, and end user viewpoints.

Among the other sessions of interest will be Session 6 on speech recognition and synthesis (Tuesday, 12:30 to 2:30 pm), Session 7 on human engineering in electronic design (Wednesday, 9 to 11 am), Session 15 on modern database management systems (Wednesday, 3:30 to 5:30 pm), and Session 16 (Thursday, 9 to 11 am) on shielding techniques and systems to meet EMI protection requirements. The following listing of sessions of interest includes names of speakers, titles of papers, and speaker affiliations. Details are those available at press time; some may change before the conference is held. For final dates, times, and places, see the official Midcon/81 program.

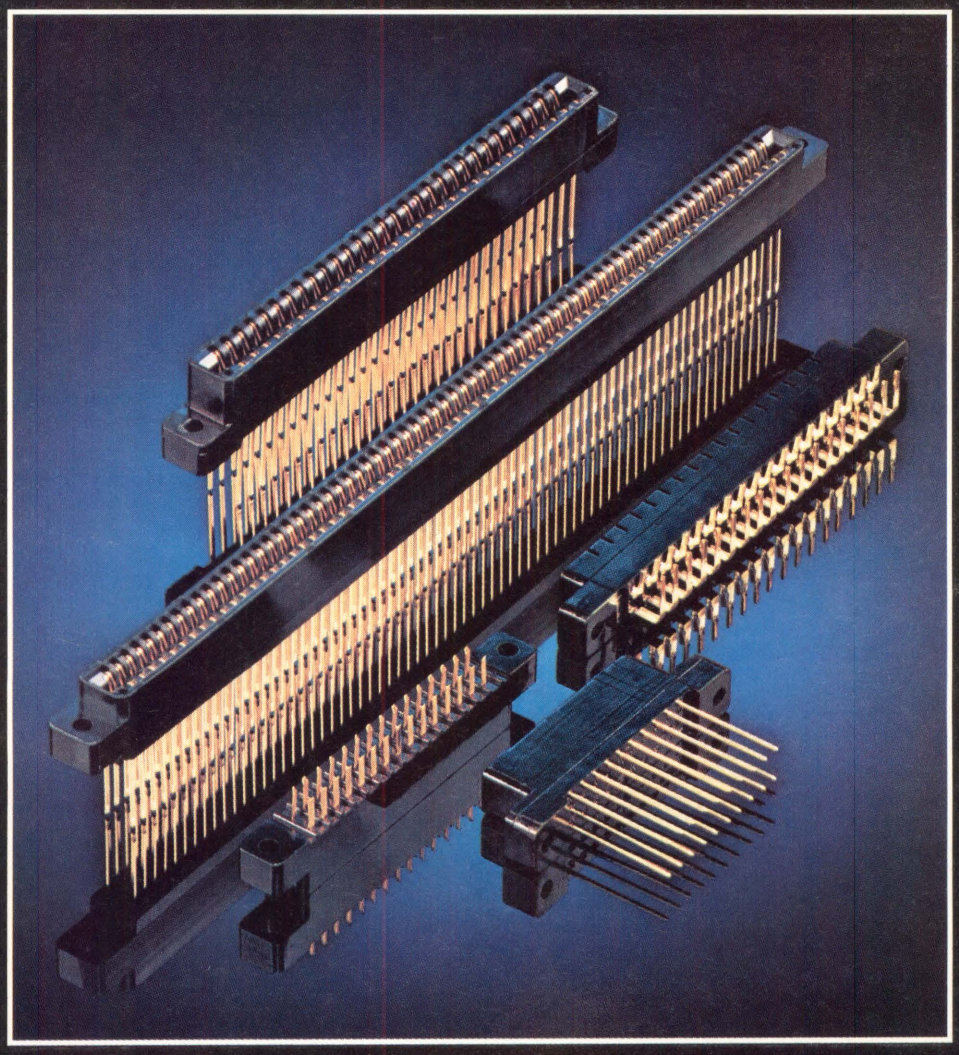
Tues, Nov 10 — 9 to 11 am

Session 2—The Logic Array Approach to Circuit Design
Organizer & Chairman: Peter Richmond, Mitel Semiconductor, Kanata, Ontario, Canada

2/1 "From Logic Design to Silicon"
Joe Kroeger, International Microcircuits, Inc, Santa Clara, Calif

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2/2 "ISO/CMOS in High Speed/Low Power Logic Array Applications"
Bob Broomfield, Mitel Semiconductor, Kanata, Ontario, Canada

2/3 "Logic Arrays, Technologies, and Designs"
Rob Walker, LSI Logic, Inc, Santa Clara, Calif

2/4 "Designing through Bipolar Logic Arrays"
Tim Chambers, Texas Instruments, Inc, Houston, Tex

Session 3—Personal Computers for Scientific and Industrial Applications

Organizer & Chairman: Mary Alys Lillard, Advanced Business Communications, Dallas, Tex

3/1 Title to be announced
John Gould, Commodore Business Machines, Bensonville, Ill

3/2 "Personal Computers in the Scientific Laboratory"
Steve Wilson, Data Acquisition Systems, Cambridge, Mass

3/3 "Data Communications for Personal Computers"
Glen R. Sirkis, Hayes Microcomputer Products, Norcross, Ga

3/4 "Interfacing a Personal Computer to a Video Disc"
Rod Daynes, Univ of Nebraska, Lincoln, Neb

12:30 to 2:30 pm

Session 5—Computer Aided Design for Custom VLSI

Organizer & Chairman: Rob Walker, LSI Logic, Santa Clara, Calif

5/1 "CAD and Gate Arrays: The Keys to Fast Turnaround IC Design"
Daniel G. Scheikert, United Technologies Microelectronics Center, Colorado Springs, Colo

5/2 "The Engineering Workstation: The Practical Approach"
Harvey C. Jones, Daisy Systems Corp, Santa Clara, Calif

5/3 "A Development System for Logic Arrays"
James Koford, LSI Logic Corp, Santa Clara, Calif

5/4 "Design Aids for VLSI"
Andras Czaplar, Compeda Inc, Menlo Park, Calif

Session 6—Speech Recognition and Synthesis

Organizer & Chairman: James J. Farrell III, Motorola, Inc, Austin, Tex

6/1 "Low Cost Voice Recognition Systems"
Sam Viglione, Interstate Electronics, Anaheim, Calif

6/2 "An Advanced Speech Processor"
Tim A. Williams, Motorola, Inc, Austin, Tex

6/3 "Double Compression Digitalker"
Fred Wickersham, National Semiconductor Corp, Santa Clara, Calif

6/4 "Single-Chip Speech Synthesizer"
Jai Gaur and Phil McLaughlin, General Instrument, Hicksville, NY

Wed, Nov 11 — 9 to 11 am

Session 7—Human Engineering in Electronic Design

Organizer & Chairman: Michael Menkin, John Fluke Mfg Co, Inc, Everett, Wash

7/1 "Audible Indicators in Electronic Measurement"
Dave Haug, John Fluke Mfg Co, Inc, Everett, Wash

7/2 "Color Graphics in Human Engineering"
Ernie John, Eagle Signal Industrial Systems, Davenport, Iowa

7/3 "Isometric Control for Positioning and Tracking"
Don Fisher, Measurement Systems, Norwalk, Conn

7/4 "Computer Interface"
Brian Rosen, Three Rivers Computer Corp, Pittsburgh, Pa

7/5 "Optimized Interfaces for Operation and Control"
Mary Kay Winter, John Fluke Mfg Co, Inc, Everett, Wash

Session 9—Virtual Memory Concepts for 16-Bit Microprocessors and Computers

Organizer & Chairman: James J. Farrell III, Motorola, Inc, Austin, Tex

9/1 "The Management of Extended Memory for Concurrent Processes in TI Microprocessor Pascal"
Larry Spry, Texas Instruments, Inc, Lewisville, Tex

9/2 "iAPX 286 Virtual Memory Distributed Processing"
Richard Markowitz, Intel Corp, Santa Clara, Calif

9/3 "Memory Management Made Easy with the Z8000 Microprocessor"
Stephen Walters, Zilog, Inc, Cupertino, Calif

9/4 "Implementation of a Virtual Memory System Using the MC68451 Memory Management Unit"
Hunter Scales, Motorola, Inc, Austin, Tex

9/5 "NSC16000 Supports Virtual Memory"
Subhash Bal, National Semiconductor Corp, Santa Clara, Calif

12:30 to 2:30 pm

Session 12—Microprocessor Peripherals Progress

Organizer & Chairman: Bill Huston, Motorola, Inc, Austin, Tex

12/1 "LSI Contribution to Local Network Technology"
Mark Stieglitz, Western Digital Corp, Newport Beach, Calif

12/2 "A Versatile Dual-Channel UART"
Alex Goldberger, Signetics Corp, Sunnyvale, Calif

12/3 "Interface Techniques for the MC146818 Realtime Clock Plus RAM"
Michael Gallup, Motorola, Inc, Austin, Tex

12/4 "Intelligent Analog Peripheral Eases Processing Burden"
Frank Toth, American Microsystems, Inc, Santa Clara, Calif

3:30 to 5:30 pm

Session 13—CMOS is Now a Microprocessor Technology

Organizer & Chairman: Bill Huston, Motorola, Inc, Austin, Tex

13/1 "Low Power Peripheral Components Solve System Design Problems"
Anne Wagner-Korne, National Semiconductor Corp, Santa Clara, Calif

13/2 "Cost Effective CMOS Microcomputers and Microprocessors"
Raghu Raghunathan, Motorola, Inc, Austin, Tex

13/3 "An Innovative Technology for Low Power Microcomputers"
Jim Millar, Texas Instruments, Inc, Houston, Tex

13/4 "C-HMOS, High Performance CMOS Microcomputer"
George S. Leach, Intel Corp, Chandler, Ariz

13/5 "An 1800 Based CRT Controller"
Richard M. Vaccarella, RCA Solid State Div, Somerville, NJ

Session 14—Recent Developments in Per Channel PCM Codec/Filters

Organizer & Chairman: Henry Wurzburg, Motorola, Inc, Austin, Tex

14/1 "A Single-Chip Per Channel Delta Sigma Modulation Codec/Filter"
Toshio Misawa, Bell Telephone Laboratories, Murray Hill, NJ

14/2 "A Single-Chip CMOS PCM Codec With Filters"
Roubik Gregorian and Glenn A. Wegner, American Microsystems, Inc, Santa Clara, Calif

14/3 "A Single-Chip Codec/Filter Combines Ease of Use with High Performance"
Steve Dreyer, Intel Corp, Chandler, Ariz

14/4 "A Single-Chip Codec/Filter Requiring No External Components"
Steve Kelley, Dick Ulmer, and Henry Wurzburg, Motorola, Inc, Austin, Tex

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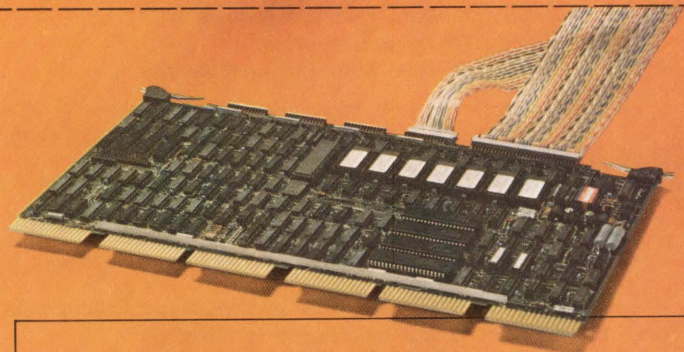
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Session 15—Modern Database Management Systems
Organizer & Chairman: Al Reszka, Bell Telephone Laboratories, Naperville, Ill

15/1 "An Overview of Modern DBMS"
Al Reszka, Bell Telephone Laboratories, Naperville, Ill, and M. M. Carlson, Northeastern Illinois Univ, Chicago, Ill

15/2 "DBMS—State of the Art"
R. C. Carlson, Bell Telephone Laboratories, Naperville, Ill

15/3 "Data Base Standardization"
T. B. Steel, AT&T, Basking Ridge, NJ

15/4 "IBM System/38's Integrated Data Base Management System"
H. J. Sylvester, IBM, Rolling Meadows, Ill

Thurs, Nov 12 — 9 to 11 am

Session 16—Shielding Techniques and Systems to Meet EMI/ESD Requirements in the '80s
Organizer & Chairman: Jack Reilly, Electro-Kinetic Systems, Wilmington, Del

16/1 "RFI Power Line Filters Selection, Specification, and Testing"
Michael B. Head, Corcom, Inc, Libertyville, Ill

16/2 "EMI Shielding with Conductive Plastic"
Robert M. Simon, Transmet Corp, Columbus, Ohio

16/3 "Conductive Shielding Coatings—Production and Testing Insights"
James Coniglio, Acheson Colloids, Port Huron, Mich

16/4 "Underwriters Laboratories Evaluation Procedures for Metalized Coatings on Plastic Substrates"
Raffic Ali, Underwriters Laboratories, Melville, NY

16/5 "Comparison Among Commercially Available Cabinet Metalizing"
Gary S. Ross, Electro-Kinetic Systems, Wilmington, Del

16/6 "Designing Business Machine Cabinets for Optimal EMI Shielding"
Grover Boothman, Wang Laboratories, Lowell, Mass

Session 18—Advanced Architectures of 16- and 32-Bit Microprocessor Systems
Organizer & Chairman: Al Reszka, Bell Telephone Laboratories, Naperville, Ill

18/1 "NS16000—Advanced Features and Capabilities"
G. R. Martin, National Semiconductor Corp, Santa Clara, Calif

18/2 "An Architecture for the '80s—The Intel iAPX 432"
H. J. Jacob, Intel Corp, Rolling Meadows, Ill

18/3 "Intel OEM System Solution"
C. C. Wiederhold, Intel Corp, Rolling Meadows, Ill

12:30 to 2:30 pm

Session 19—Telecommunications from the User's Viewpoint
Organizer: Jim Jordan, ERA/Moxon Electronics, Anaheim, Calif
Chairman: Charles Tindal, ERA/Col-Ins-Co, Inc, Orlando, Fla

19/1 "Basic Telecommunication Terminology"
Larry Broadway, ERA/Barnhill Three, Inc, Englewood, Colo

19/2 "Present Modem Technology"
Charles Tindal, ERA/Col-Ins-Co, Inc, Orlando, Fla

19/3 "Reduction of Transmission Costs"
Jim Switzer, ERA/S.E.A., Inc, Carmel, Ind

19/4 "Future Developments"
Jim Jordan, ERA/Moxon Electronics, Anaheim, Calif

Session 20—Single-Chip Microcomputers Part 1—System Aspects
Organizer & Chairman: Bill Huston, Motorola, Inc, Austin, Tex

20/1 "Single-Chip Microcomputers in Distributed Control Applications"
Don Folkes, Mostek Corp, Carrollton, Tex

20/2 "EPROM MCU with A-D for Dedicated Data Acquisition"
Ed Peatrowsky, Motorola, Inc, Austin, Tex

20/3 "Expansion Applications of Single-Chip Microcomputers"
Randy Dumse, Rockwell International, Anaheim, Calif

20/4 "An Innovative Microcomputer for the '80s"
Jim Millar and Mike Patrick, Texas Instruments, Inc, Houston, Tex

20/5 "The Advanced Hardware Features of the Z8 Microcomputer Family"
Peter Brown, Zilog, Inc, Cupertino, Calif

3:30 to 5:30 pm

Session 22—Applications for Semiconductor Memory
Organizer & Chairman: Mary Phinney, Mostek Corp, Carrollton, Tex

22/1 "Dynamic RAM—The High Density Solution for the '80s"
Mary Phinney, Mostek Corp, Carrollton, Tex

22/2 "Semiconductor Solutions to Nonvolatility"
Michael Bolan and Sandy Scherpenberg, Mostek Corp, Carrollton, Tex

22/3 "Microprocessor Memory Solutions"
Barbara Nelson, Intel Corp, Aloha, Ore

22/4 "Total CMOS Memory System Design"
Walt Niewierski and Russell M. Pate, Harris Semiconductor, Melbourne, Fla

Session 23—Single-Chip Microcomputers Part 2—Programming Aspects
Organizer & Chairman: Bill Huston, Motorola, Inc, Austin, Tex

23/1 "Programming Single-Chip Microcomputers Without Pain"
Vern Goler, Motorola, Inc, Austin, Tex

23/2 "Benchmark Considerations in Processor Selection"
Peggy Whalen, Rockwell International, Anaheim, Calif

23/3 "Single-Chip Microcomputer Programming Made Easy with the TMS 7000"
Mike Patrick and Jim Millar, Texas Instruments, Inc, Houston, Tex

23/4 "Software Techniques for Single-Chip Microcontrollers"
Frank Toth, American Microsystems, Inc, Santa Clara, Calif

23/5 "UPD7500 Family of 4-Bit Microcomputers, Big Jobs With Small Programs"
Ted Knowlton, NEC Microcomputers, Inc, Wellesley, Mass

Session 24—Microcomputer Bus Structures—What the Future Holds
Co-organizers: Sheldon Edelman, Marken Communications, Palo Alto, Calif, and Jim Spackman, Texas Instruments, Inc, Houston, Tex
Co-chairmen: David Wertzberger, SSM Microcomputer Products, San Jose, Calif, and Jim Spackman, Texas Instruments, Inc, Houston, Tex

24/1 "STD Bus: A Standard for the '80s"
William C. Cummings, Mostek Corp, Carrollton, Tex

24/2 "The Multibus/IEEE-P796 Bus Standard—The Multiprocessing Bus of the '80s"
Joseph Barthmaier and Ronald Dilbeck, Intel-OMS, Hillsboro, Ore

24/3 "IEEE P696.1: The Bus Whose Time Has Come"
Malcolm Wright, SSM Microcomputer Products, San Jose, Calif

24/4 "Functional Architecture: Optimizing a Powerful System Bus Solution"
Leon Adams, Texas Instruments, Inc, Houston, Tex

24/5 "The Advanced Microcomputer System Bus—IEEE P896"
Andrew Allison, Consultant, Los Altos, Calif

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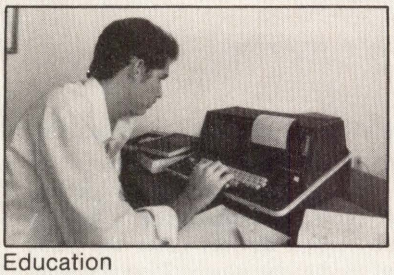
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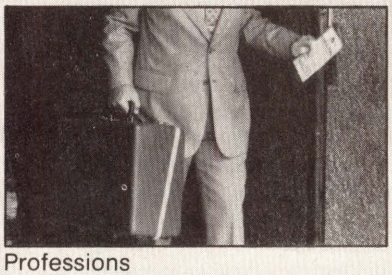
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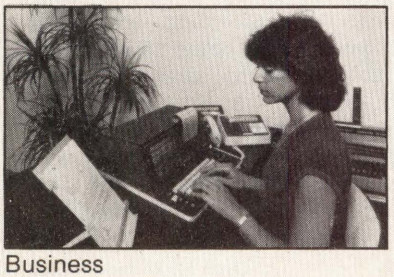
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Circle 341 on Inquiry Card

4k CMOS static RAM

MP2114C has a 1024 x 4 memory configuration and 250-ns access time, interfaces with numerous microprocessors, and is pin-compatible with industry std N-channel 2114. Powered from single 5-V supply, device retains data even when power drops to 2 V. Absolute max voltage of 7 V allows for 4 fully charged 1.5-V batteries in portable applications. Inputs and outputs are fully TTL compatible. A 3-state output and onchip address registers allow easy interfacing. **Micro Power Systems, Inc,** 3100 Alfred St, Santa Clara, CA 95050.

Circle 342 on Inquiry Card

Quad-high speed bus transceiver

A pin for pin functional replacement for DS8641 transceivers, DS3662 transmits and receives only precise trapezoidal bus waveforms, increasing integrity and dependability of micro- and minicomputer systems. Noise spikes up to 20 ns are ignored without sacrificing data rate. Features include guaranteed ac specifications over entire temperature and supply voltage range and glitch-free power-up/down protection. **National Semiconductor Corp,** 2900 Semiconductor Dr, Santa Clara, CA 95051.

Circle 343 on Inquiry Card

High speed 16 x 16 multiplier

WTL1016 parallel array NMOS multiplier is a pin for pin functional replacement for the bipolar TRW MPY16HJ multiplier circuit. Typical multiply time is 100 ns; typical power consumption is 1 to 2 W. I/O latches operate in either clocked or transparent mode. Input data are accepted in the form of 16-bit 2's complement or unsigned magnitude in mixed or unmixed mode. Multiplier operates on 5-V power supply. **Weitek Corp,** 3255 Scott Blvd, Bldg 2B, Santa Clara, CA 95050.

Circle 344 on Inquiry Card

64k bipolar P/ROM

HM-76641 offers 4-times the capacity of currently available 16k P/ROMs in the same 24-pin package, with approx 25% of the power dissipation per bit. Programmed using available commercial P/ROM programming equipment, P/ROM is provided in an 8k-word x 8-bit/word format and is guaranteed over commercial temp and voltage ranges. Address access time is 85 ns, max. Quantity 100 price is approx $250. **Harris Corp, Semiconductor Group,** PO Box 883, Melbourne, FL 32901.

Circle 345 on Inquiry Card

P/ROM set provides power-up diagnostics for LSI/PDP-11

A set of P/ROMs that provide power-up diagnostics as well as bootstrap code for DEC LSI-11 and PDP-11/23 processors, DiPROM18 functions as a direct replacement for DEC's bootstrap P/ROM (MXV11-A2). Two 512-byte P/ROMs boot either the RL01 or RX02 load device, selectable by a single jumper on the MXV11. In addition to bootstrap code, diagnostics check the CPU, the host memory, and the selected load device.

Firmware prints an encoded message, VERIFIED, which indicates the testing progression. All failures are indicated by the lack of a complete encoded message. In addition, a specific error message is displayed identifying CPU, memory, or disc failure. The program counter is identified, by debugger, to further allow the user to examine the appropriate registers. This feature aids the user in identifying the failing module.

An exclusive self-checking feature verifies the contents of the P/ROM prior to diagnostic checking and bootstrap. Each set contains a unique System ID number that can be used for operating system verification of the hardware and software protection.

Unit price of $85 includes manual and pocket reference card. OEM quantity discounts are available. **Dice Systems, Inc,** 7½ Harris Rd, Nashua, NH 03062.

Circle 346 on Inquiry Card

Electrically alterable nonvolatile memory

ER5716 EEPROM, based on N-channel silicon gate MNOS technology, serves as a second source for Hitachi's HN48016. The 16k-bit device features a 2k-word x 8-bit organization, and requires a single 5-V supply in read mode and a 25-V supply for erase and write. Access time is 300 ns; power dissipation is 300 mW max. Unit is bulk erasable and can be electronically reprogrammed incircuit. **General Instrument Corp, Microelectronics Div,** 600 W John St, Hicksville, NY 11802.

Circle 347 on Inquiry Card

16k static RAMs

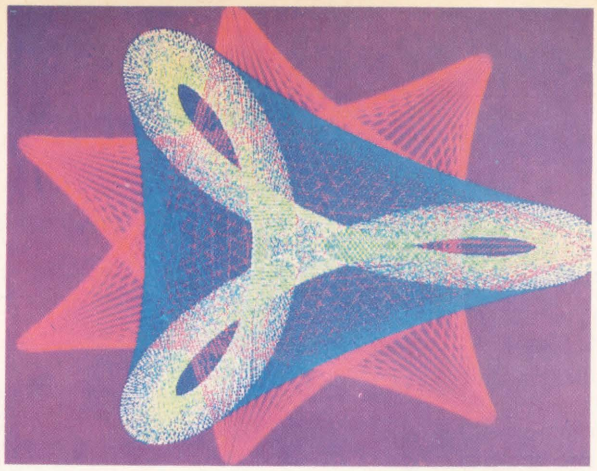
IMS1420, organized as 4k x 4, features chip-enable access times up to 45 ns with max power consumption of 600 mW (110 mW in standby). A replacement for 4k x 1 and 1k x 4 fast static RAMs, the chip reduces board space and cuts power consumption by at least a factor of 4. IMS1421 sister part is also organized as 4k x 4, and provides high speed chip-select function that allows chip-select access times as fast as 30 ns. **INMOS,** PO Box 16000, Colorado Springs, CO 80935.

Circle 348 on Inquiry Card

CMOS versions of 74LS components

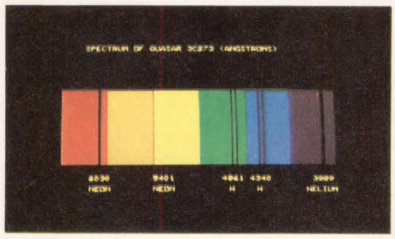
SP74SC components, replacements for 74LS devices, solve marginal performance problems experienced in existing designs. CMOS devices offer the same pinout as the low power Schottky components, while providing significantly lower power, wider power supply range, high noise immunity, comparable high speed, and full TTL I/O compatibility. Family includes most widely used 74LS components, including decoders, multiplexers, octal drivers, transceivers, flip-flops, and latches. **Semi Processes, Inc,** 1885 Norman Ave, Santa Clara, CA 95051.

Circle 349 on Inquiry Card





"...stands well above other S-100 graphics displays in its price and performance range."
BYTE, Product Review



"...better monochromatic ...display...."
ELECTRONIC DESIGN, 1981 Technology Forecast

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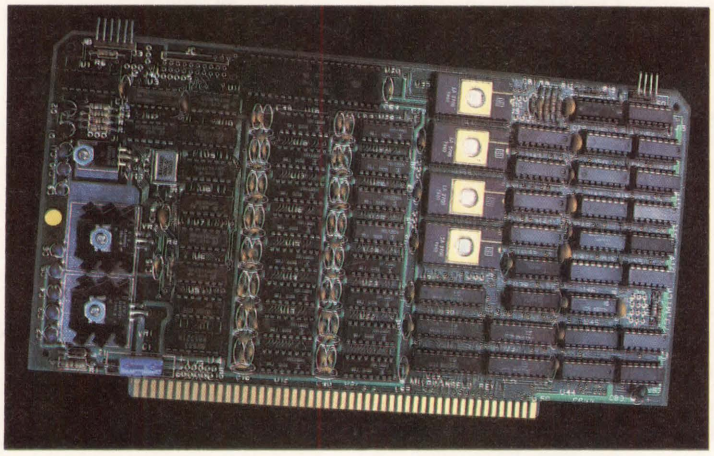
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32K RAM isolated from host address space

High speed communications over parallel bus ports

Screenware™ Pak I

A 4K byte operating system resident in PROM on MicroAngelo™. Pak I emulates an 85 character by 40 line graphics terminal and provides over 40 graphics commands. Provisions exist for user defined character sets and directly callable user extensions to Screenware™ Pak I.

Screenware™ Pak II

An optional software superset of Pak I which adds circle generation, polygon flood, programmable split screen for separate graphics and terminal I/O, relative coordinates, faster vector and character plotting, a macro facility, full UCSD Pascal compatibility, and more.

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DATA COMMUNICATIONS

Fiber optic transmitter sends low level signals up to 1.7 km

A self-contained transmitter module, 3714T, accepts analog signals, amplifies them, converts them into a frequency formatted digital pulse train, and then converts them to a light output. When connected to a suitable fiber optic cable and receiver, the device forms a data link capable of transmitting analog input signals as small as 10 mV full scale, for a distance up to 1.7 km with a typical linearity error of 0.005%. The link output is a TTL digital pulse train that can be interfaced to a counter for A-D conversion or converted back to analog form with a frequency to voltage converter. In addition, the device will transmit a CMOS logic signal at data rates from dc to 2M baud NRZ. The transmitted signal is unaffected by high voltage, intense electric or magnetic fields, and a variety of other noise sources.

A precision instrumentation amplifier provides input impedance of 10^{10} Ω, CMR of 106 dB, programmable gain up to 1000 V/V, and level shifting for ±5-V max bipolar signals. Input voltages between 0 and 10 V are linearly converted to an adjustable pulse train ranging from 0 to 50 kHz by a linear voltage to frequency converter. A dc input produces a fixed frequency output, and a dynamic analog input produces a frequency modulated output. The fiber optic transmitter section drives the output LED at a resistor programmable power level. Price is $93.75 in quantities of 100. **Burr-Brown, Research Corp,** International Airport Industrial Pk, PO Box 11400, Tucson, AZ 85734.

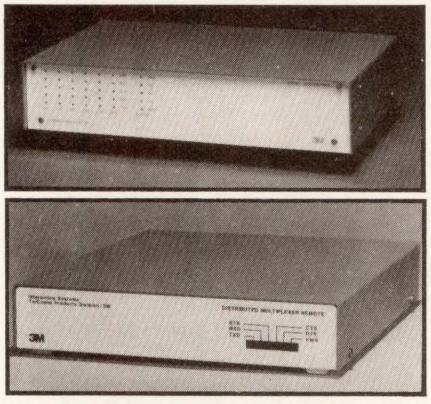
Circle 350 on Inquiry Card

Limited distance modem

Model 8250 Local Distribution Service Unit, designed for use with twisted pair cable or TELCO Local Area Data Channels, operates at speeds from 2400 to 19,200 bits/s over distances up to 23 mi. Features include remote unattended diagnostics, point to point and multipoint operation, full range of status indicators, and dedicated onboard dc power supply. Performance is achieved through use of differential diphase modulation technique, timing circuitry, and automatic equalizer. **Codex, Subsidiary of Motorola Inc,** 20 Cabot Blvd, Mansfield, MA 02048.

Circle 351 on Inquiry Card

Asynchronous distributed multiplexer system



Model 650 provides 6 full-duplex data channels between 6 I/O ports of a computer and up to 6 CRT terminals or printers distributed anywhere along a coaxial cable network. Exact bit rate on each subchannel is switch-selectable at each headend unit (model 651 MUX) and at each remote modem unit (model 652); rates range from 75 to 9600 bits/s. Multiplexer forward and reverse transmissions occur in frequency ranges of 216 to 246 MHz and 24 to 54 MHz, respectively. **Interactive Systems/3M, TeleComm Products Div,** PO Box 33600, St Paul, MN 55133.

Circle 352 on Inquiry Card

300-baud modem filter set

Compatible with Bell 103/113 modems, CTS 1262 and 1267 provide transmit and receive filtering with associated circuitry. CTS 1262 FSK Transmit Hybrid, a switchable bandpass filter, includes a 2-to-4 wire converter and voltage controlled squelch in a 16-pin ceramic DIP. Center frequencies are 1170 and 2125 Hz, bandwidth is 500 Hz, ripple is 0.5 dB, and power consumption is 180 mW. CTS 1267 FSK Receive Hybrid is a switchable bandpass/band reject filter and a soft-limiter/amplifier. Center frequencies are 1170 and 2125 Hz, bandwidth is 500 Hz, passband ripple is 1 dB, and total power consumption is 360 mW. **CTS Microelectronics, Inc,** PO Box 1278, Lafayette, IN 47902.

Circle 353 on Inquiry Card



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CIRCLE 117 ON INQUIRY CARD

DATA COMMUNICATIONS

3-km transmission option for light wave multiplexer

Option doubles the distance allowed between 2 LM9500 multiplexers. Multiplexing up to 16 EIA data channels over an optical fiber to a host computer or other device, multiplexer accommodates any data character format and is transparent to any data protocol. Option is priced at $200 for 8- or 16-port unprotected configuration, and at $400 for 16-port protected configuration. **Digital Communications Corp,** 11717 Exploration Lane, Germantown, MD 20767.

Circle 354 on Inquiry Card

Synchronous limited distance modem



LDM720 operates in full-duplex mode at speeds ranging from 1800 to 19,200 bits/s and meets Bell Technical Reference Publication 43401 transmission requirements. Modem can be installed in point to point or multipoint systems on both 2- and 4-wire unloaded metallic circuits up to 20 mi (32 km) in length (depending on bit rate and wire gauge of phone line). Switch-selectable test circuits test modem, terminal, and metallic line. Modem is available as a standalone desktop unit or as a card modem for multiple rack mounting. **Rixon Inc,** 2120 Industrial Pkwy, Silver Spring, MD 20904.

Circle 355 on Inquiry Card

Data concentrators

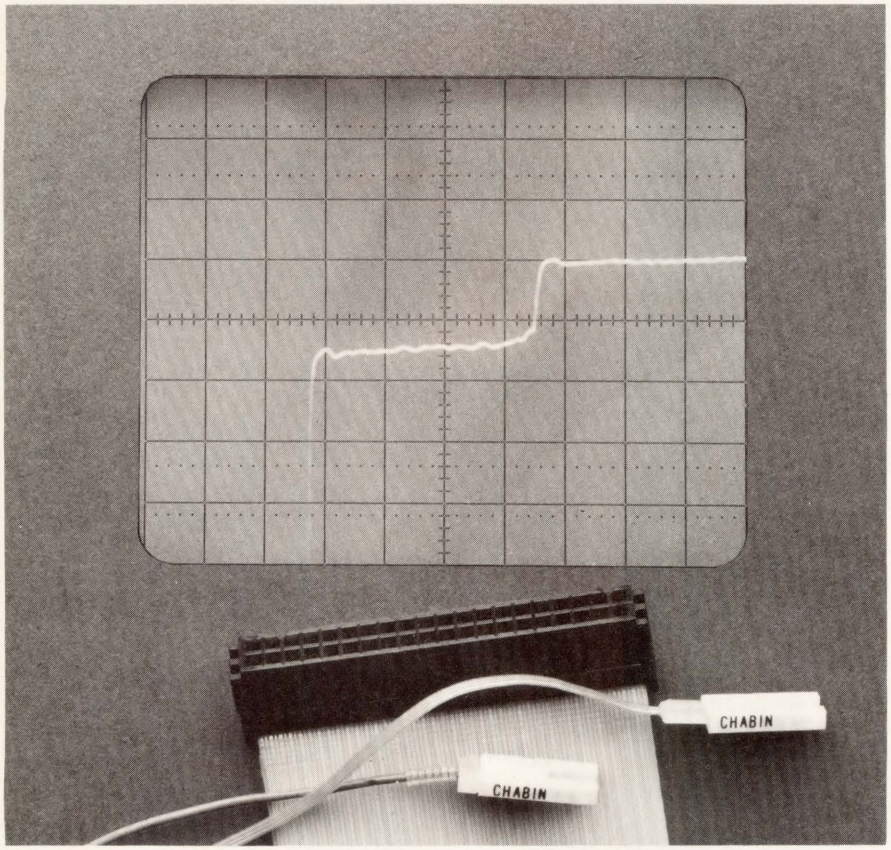
Three "No Frills™" models feature switch-selected asynchronous composite (output) rates of 9600, 1800, or 1200 bits/s, and support for any synchronous rates within that range. The sum of the input terminal rates connected to the concentrators can be as much as 38,400 bits/s, and this aggregate can be composed of switch-selected rates from 50 to 9600 bits/s, full- or half-duplex. **Micom Systems, Inc,** 20151 Nordhoff St, Chatsworth, CA 91311.

Circle 356 on Inquiry Card

Smart communications controller

8103 enhances system performance using a dedicated 8085 microprocessor to control serial RS-232 and Bell 202 communications requirements. Data are passed through dual-port RAM, reducing system overhead and allowing the implementation of multiple communications schemes. Functionally partitioned into three major sections—CPU components, serial communications interface, and dual-port RAM—device is configured for the MULTIBUS™. **ETI Micro,** 6918 Sierra Ct, Dublin, CA 94566.

Circle 357 on Inquiry Card



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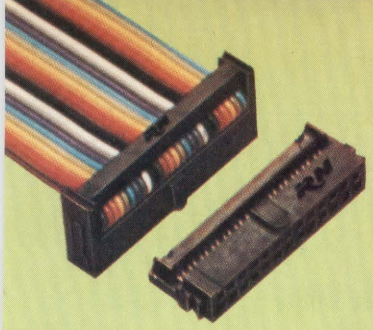
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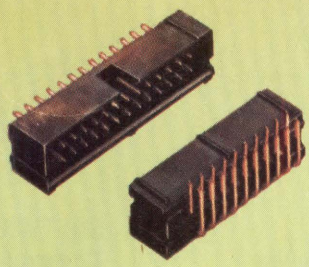
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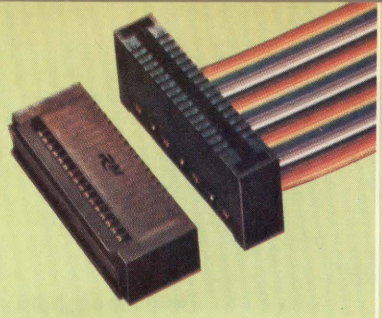
CIRCLE 120 ON INQUIRY CARD



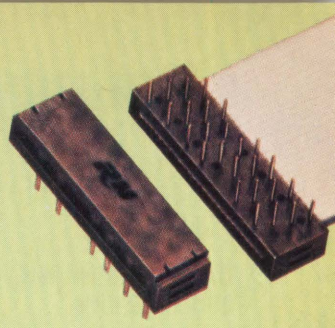
Socket Connectors
IDS Series—Optional strain relief.



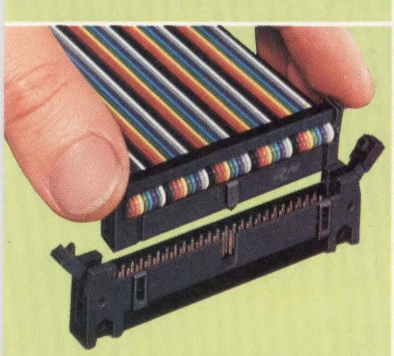
Low Profile Headers
IDH/LP Series—Low profile for high density packaging.



Edge Card Connectors
IDE Series—Three mounting options available.



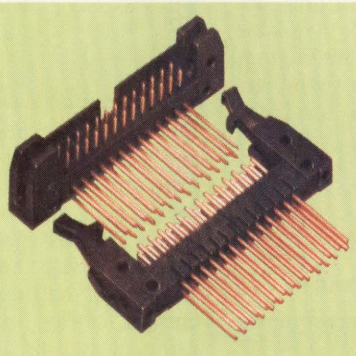
Transition Connectors
IDT Series—Cover latch swivels for easy cable insertion.



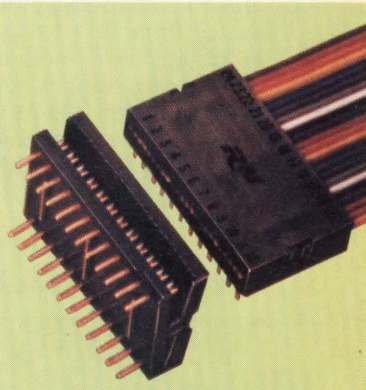
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90% ain't bad

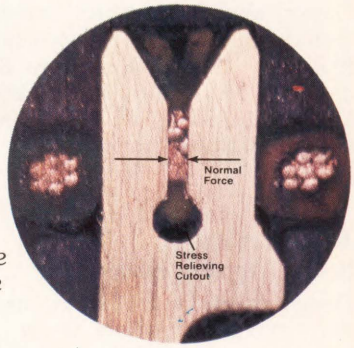
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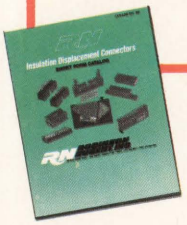
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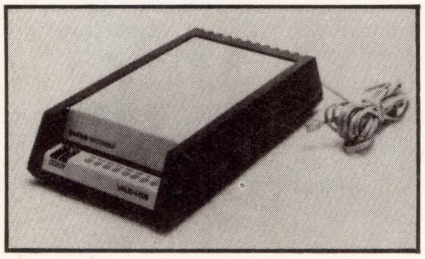
DATA COMMUNICATIONS

300/1200-bit/s originate-answer modem

Astrocom 212A, based on 2 custom Bell-designed MOS LSI chips, offers full end-to end compatibility with virtually all 212 type units. Modem features integrated "originate" control key, function indicators, and diagnostic features activated from the front panel. Available in freestanding or rackmount configurations, device features design simplifications that allow the user to install the unit in minutes. **Astrocom,** 120 W Plato Blvd, St Paul, MN 55107.

Circle 358 on Inquiry Card

2400-bit/s direct connect modem



A direct replacement for Bell 201B/C, VA2450/55 is FCC registered for direct connect to the switched network via voice or programmable data jacks; voice/data switch eliminates need for special telephones. A switch-selectable 75- or 150-bit/s auxiliary channel can be used in either forward or reverse mode. Device also incorporates power test features, interface display, local (analog) loopback, "Force Request to Send," and a self-test feature. **Racal-Vadic,** 222 Caspian Dr, Sunnyvale, CA 94086.

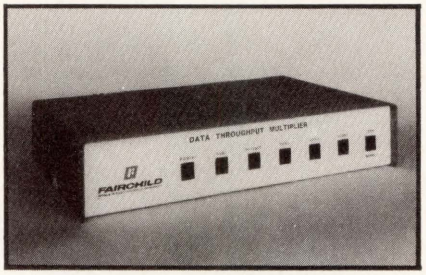
Circle 359 on Inquiry Card

Asynchronous limited distance modem

Designed for asynchronous operation over TELCO or private 2- or 4-wire nonloaded metallic (twisted pair) conductors at speeds up to 9600 bits/s, 6210 can be used in point to point and multidrop network configurations and is suited for local data distribution up to 7 mi using conventional 26-gauge wire. Internal strap selections are provided for constant or controlled RTS, high or low transmit level, 2- or 4-wire operation, and normal or high receiver impedance. **International Data Sciences, Inc,** 7 Wellington Rd, Lincoln, RI 02865.

Circle 360 on Inquiry Card

Data throughput multiplier



DIM, consisting of 2 RS-232-C interfaces and an intelligent protocol translator program, increases data throughput by a factor of 3 on any digital communications channel that has transmission delays. Device converts terminal (or computer) half-duplex protocol into custom, delay insensitive full-duplex protocol that is interfaced to a full-duplex modem and transmitted over link at rates up to 19.2k baud/s. An identical device converts internal protocol back to original form. **Fairchild Space & Electronics Co,** Germantown, MD 20760.

Circle 361 on Inquiry Card

Intelligent modem

Model 1012, a Bell 212A compatible unit with both 300- and 1200-baud full-duplex modes, uses the company's keyboard dialing technology to provide user friendly operation. Modem can also be configured for computer installations requiring auto-dialing and/or auto-answer capabilities. Device eliminates need for separate low speed modem by integrating a Bell 103 compatible FSK data set into the compact desktop enclosure. Modem offers access to Telenet, Tymnet, and online data banks. **Bizcomp Corp,** PO Box 7498, Menlo Park, CA 94025.

Circle 362 on Inquiry Card

SOFTWARE

Communications utility software package

TCUP allows users of Burroughs B1000 computers to create and maintain online and batch processing systems. Consisting of message control system to control communication between terminals and online applications programs, job execution system to execute and monitor a series of batch programs without operator intervention, and screen formatter package that allow users to design and generate code for CRT screens in online applications, package requires MCP operating system and up to 50k bytes of memory. **Technalysis Corp,** 6700 France Ave S, Minneapolis, MN 55435.

Circle 363 on Inquiry Card

CP/M compatible utility software

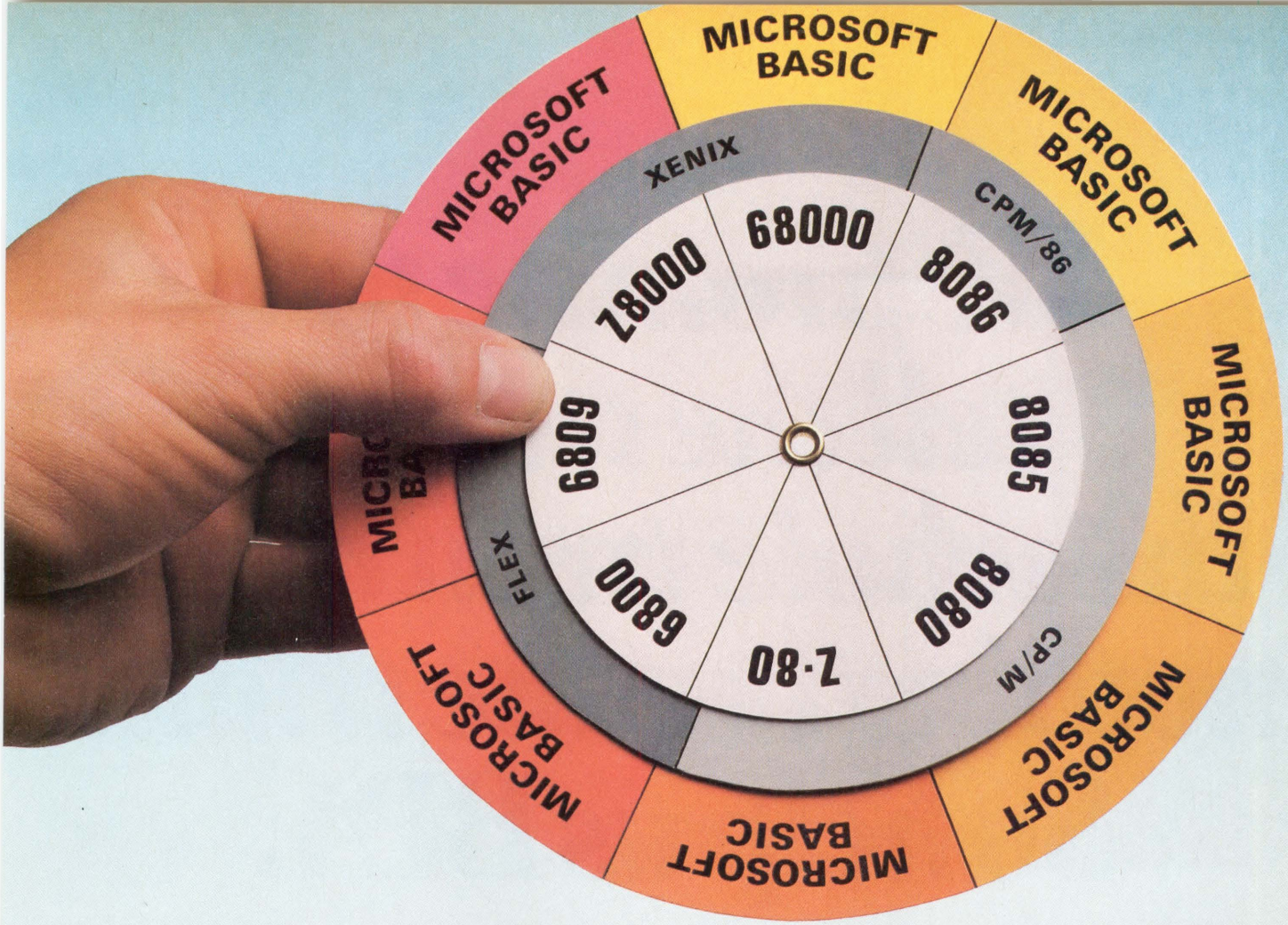
WordMaster version 1.07 video text editor and SuperSort version 1.5 sorting utility program are offered for Heath H-8, H-89, and Zenith Z-89 computers. WordMaster includes video edit mode, automatic floppy disc I/O scratchpad memory, and ability to read/write text to or from files other than file being edited. System requires 32k bytes of RAM and Heath CP/M operating system. SuperSort sorts, merges, and selects records from data files compatible with BASIC, Assembly, FORTRAN, and COBOL applications programs. SuperSort requires 48k bytes of RAM and Heath CP/M. **Heath Co,** Benton Harbor, MI 49022.

Circle 364 on Inquiry Card

Remote batch terminal emulator

RBTE package allows System Two, System Three, and Z-2H hard disc computers to functionally emulate IBM 3780, 3741, 2980, and 2770 data terminals using bisync protocol. Software package also allows the company's computers to send files to each other or to other computer systems over dial-up, leased, or private telephone lines. Data rates from 1200 to 9600 baud are supported; data can be transferred transparently or nontransparently. Complete, fully automatic, two-way conversion from ASCII to EBCDIC is provided. **Cromemco, Inc,** 280 Bernardo Ave, Mountain View, CA 94043.

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If they write it in Microsoft BASIC they'll only write it once.

Transparent BASICs. Microsoft BASIC implementations are user-transparent from system to system. That's what makes them the defacto standard of the industry. Applications programs written in Microsoft BASIC are transportable across systems with little or no modification. That's a powerful selling tool for an OEM. When a customer is ready to move up to a new system, applications software written in Microsoft BASIC is ready to move, too. That's why more OEMs build systems with Microsoft BASIC than with any other implementation of the language.

More BASICs. There are Microsoft BASICs for Z80, 8080, 6800, 6809 and 6502 microprocessors. Off the shelf BASICs for CP/M® and FLEX. There are Microsoft BASICs for the 8086 and Z8000 under such operating systems as CP/M-86® or the XENIX® OS. All of which means that when you're ready to migrate, you or your customers won't have to start developing applications programs from scratch.

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CP/M is a trademark of Digital Research, Inc.
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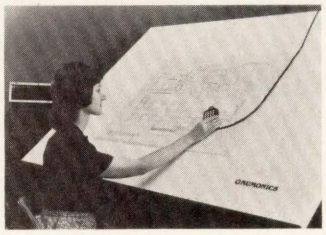
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SOFTWARE

FORTRAN compiler supports 8- and 16-bit microprocessor development

A FORTRAN compiler designed to run on an Intellec series III microcomputer development system is available for 16-bit iAPX 86 and 8-bit iAPX 88 microprocessors. FORTRAN 88/86 is compatible with ANSI FORTRAN 77 specification and is enhanced for microcomputer applications, with extensions for direct byte- or word-oriented I/O control, procedures for reentrant code execution, and interrupt procedures.

A flexible diskette contains the compiler plus libraries of runtime support routines. The software package features extensive high level language support for numeric data processing and generates inline object code that is optimized for the iAPX 86/20 or 88/20 numeric data processor. It executes numeric functions and supports the proposed IEEE floating point standard. The user writes FORTRAN source code and the compiler, running under the ISIS operating system, converts the source code into object code. FORTRAN applications programs can be debugged and integrated using appropriate incircuit emulation modules. **Intel Corp,** 3200 Lakeside Dr, Santa Clara, CA 95051.

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Microprocessor development software

Supporting applications development for Intel's 8051 microprocessor, Microbench™ 8051 series programs include relocating assembler, linking loader, librarian, and object file formatter. Coded in MACRO-11 for high throughput, programs operate on DEC PDP-11, LSI-11, and VAX computers, and run under all DEC and UNIX operating systems. Perpetual license fees start at $1900. **Virtual Systems, Inc,** 1500 Newell Ave, #406, Walnut Creek, CA 94596.

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Realtime graphics software support package

IGOR 1™ uses Sanders Associates' Graphic 7 vector refresh and Graphic 8 raster display systems to provide realtime support for applications requiring high image update rates and operator interactivity levels. Features include multitasking capability, debugging support, and I/O primitives. Standalone package is offered for use with DEC PDP-11 IAS or RSX-11M, or VAX-11/780 VMS operating system. **Interactive Graphic Systems, Inc,** French Quarter Plaza, Suite 225, 20969 Ventura Blvd, Woodland Hills, CA 91365.

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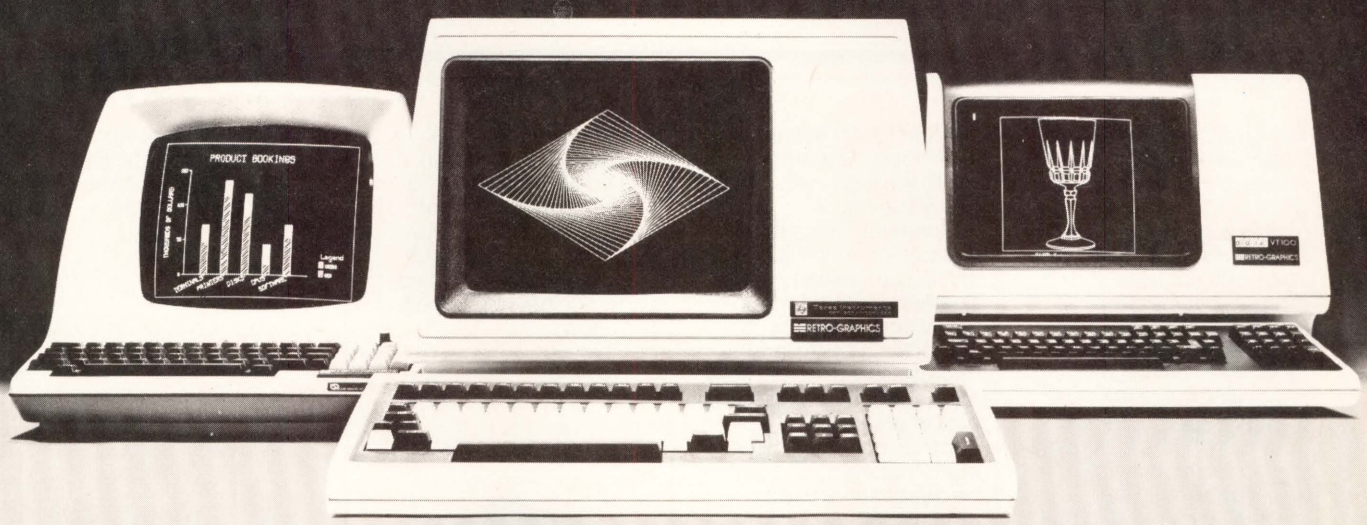
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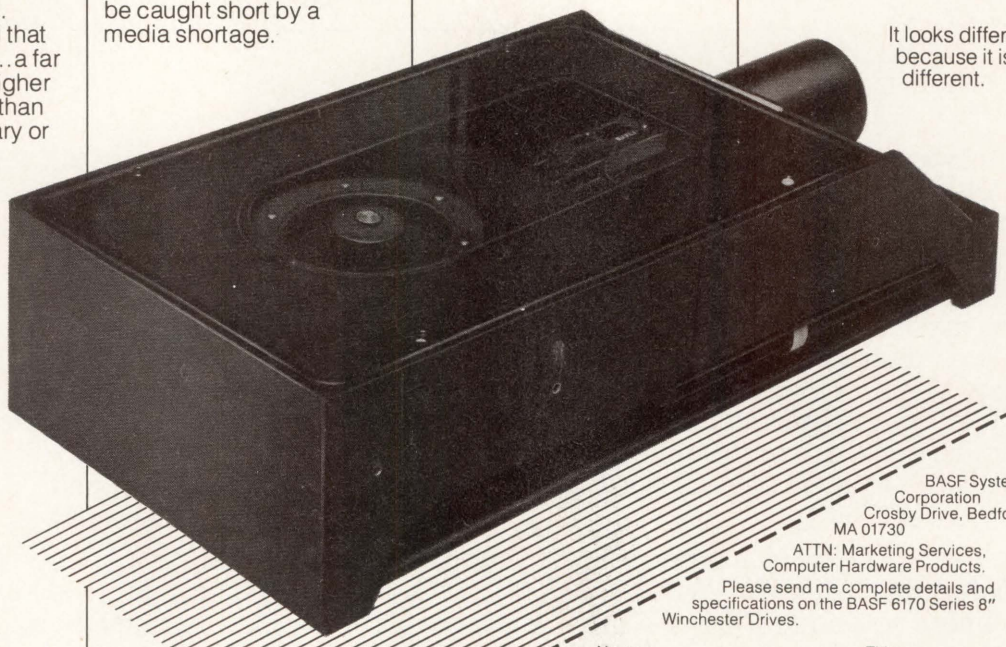
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OEM AMERICA MEETS AT THE INVITATIONAL COMPUTER CONFERENCES

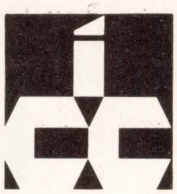


Every type of computer and peripheral—mini/micros, disk drives, tape drives, printers, interfaces, CRTs—will be on display at the Invitational Computer Conferences, the only one-day regional seminar/displays directed exclusively to the needs of the quantity buyer. During the 1980/1981 series, over 7,000 OEMs attended the conferences to receive a concentrated, close-up view of the newest computer and peripheral equipment presented by forty of the world's top manufacturers, as well as to attend a program of technical seminars covering the latest state-of-the-art technology.

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Oct. 27, 1981	**Valley Forge, PA**
Oct. 29, 1981	**Washington, D.C.**
Nov. 17, 1981	**Palo Alto, CA**
Jan. 14, 1982	**Orange County, CA**
Feb. 10, 1982	**Ft. Lauderdale, FLA**
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Invitations are available from participating companies or the ICC sponsor. For further information contact B.J. Johnson & Associates, Inc., 2503 Eastbluff Drive, Suite 203, Newport Beach, CA 92660. (714) 644-6037.

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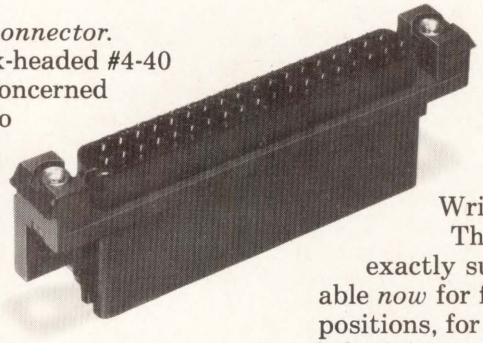
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SOFTWARE

6809 native code Pascal compiler

Compiler operates under 6809 FLEX™ and UniFLEX™ operating systems and produces 6809 assembly language source mnemonics that are assembled into object code. Native code results in faster program execution than common "P-code" interpreter Pascals. Compiler supports most Jensen and Wirth Pascal specifications, plus additional features related to the operating system, including integer and floating point math with 16.8-digit accuracy. **Technical Systems Consultants, Inc,** PO Box 2570, West Lafayette, IN 47906.

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Streaming RDOS-based software

Stream RDOS, designed for use with Data General's NOVA® and ECLIPSE® minicomputers, transfers RDOS compatible discs to formatted 100″ (254-cm)/s streaming tape drives via the SPECTRA 20 emulating multifunction disc/tape controller. Designed for both start/stop and streaming 0.5″ (1.3-cm) formatted tape drives, the package is available on DG/ANSI compatible 800- or 1600-bit/in (315 or 236/cm) magnetic tape. One-time charge is $500. **Spectra Logic Corp,** 1227 Innsbruck Dr, Sunnyvale, CA 94086.

Circle 370 on Inquiry Card

Networking facility for DEC systems

TSX-NET file transfer utility for DEC LSI-11 and PDP-11 computers running RT-11, or S & H Computer Systems' TSX or TSX Plus operating systems, provides transparent access to remote files and devices down to the block and record level. It allows use of std system utilities, and permits remote file access by user written programs using std file access techniques. "Silent" access to RT-11 remote data entry or remote data collection systems is possible. **Glenn A. Barber & Assoc, Inc,** 110 W Broadway, Suite 304, Glendale, CA 91204.

Circle 371 on Inquiry Card

Z8000 symbolic debugger

SI/Z8000 realtime debugger for Zilog and AMD Z8000 supports all 32-bit expression handling capabilities of the Z8000. It also permits multiple segment addressing to a total memory space of 64k bytes. User defined command constructs are available to automatically initialize debugging parameters. Other capabilities include program modification from within the debugger; file access for storing input, output, or interrupt data simulation; and flexible screen drivers modifiable for data display. **Boston Systems Office,** 469 Moody St, Waltham, MA 02154.

Circle 372 on Inquiry Card

Data dictionary software

DD-990 enables users to set up and maintain definitions of DBMS files and conventional files stored in the DS990's data base. Dictionary stored information can include list of categories and subcategories in a file, explanation of abbreviations used in a file, list of programs that access a file, actions that a program performs on a file, and program format of each file. Package can also generate reports describing data organization and analyze impact of proposed changes in user's data. **Texas Instruments Inc, Digital Systems Group,** PO Box 202146, Dallas, TX 75220.

Circle 373 on Inquiry Card

Full ANSI COBOL compiler

Designed to operate in HP/1000 RTE-IV environment that implements ANSI X3.23 COBOL spec, COBOL/1000 compiler allows users to transport commercially available COBOL based programs to the HP/1000. It produces object code that will also run on HP's L-series computers. Compiler is available on 800- or 1600-bit/in (315 or 630/cm), 9-track magnetic tape, or on mini-cartridges. **Corporate Computer Systems, Inc,** 675 Line Rd, Aberdeen, NJ 07747.

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Measurement/control software support package

AC1815 consists of loadable device driver and interface module that frees users of RSX-11S and -11M based systems from designing software to control the μMAC-4000 intelligent measurement and control system. Package supports party line (multidrop) or radial system configuration and multiple retransmission, parity, and checksum error checking. Compatible with the RX01 diskette drive, package occupies 1.5k words of memory and is written in MACRO-11. Price is $990. **Analog Devices, Inc,** Rte 1 Industrial Park, Norwood, MA 02062.

Circle 375 on Inquiry Card

Interactive graphics software

SIMCHART™ combines computer graphics and simulation capabilities to produce visual displays of simulation output. Together with a graphics display device, package creates presentation quality plots, histograms, and pie charts and graphs, improving data analysis and display capabilities while reducing manpower requirements. **Pritsker & Associates, Inc,** PO Box 2413, West Lafayette, IN 47906.

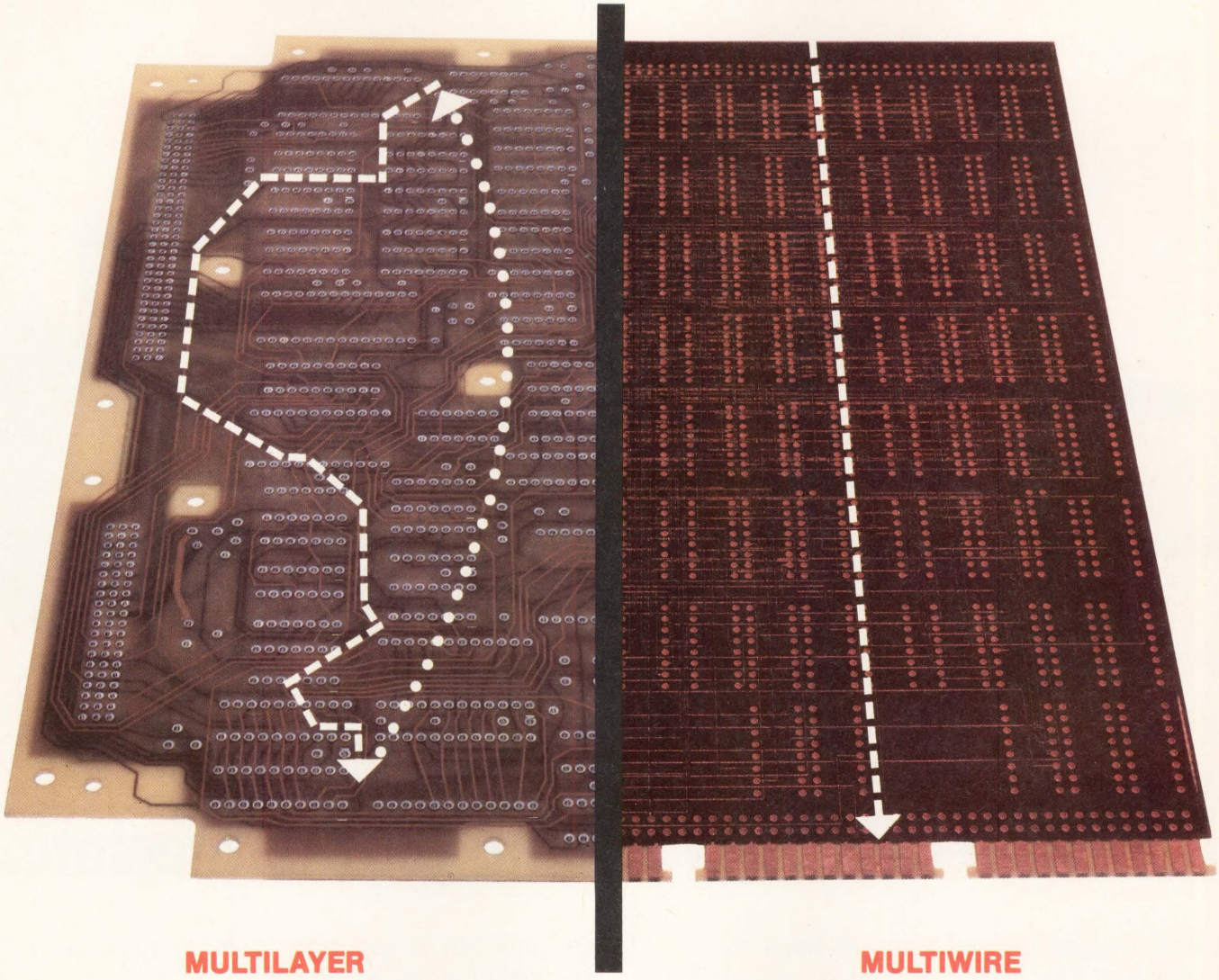
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Data management system

Extension of BASIS data management system enables it to operate on 32-bit Prime computers. Capabilities include index and actual data records searching; proximity and range searching; prefix searching; and hierarchical, universe, and mapped searching. Transaction profiles can be generated and information sorted online or put into thesaurus where vocabulary can be standardized. System also allows reports to be defined and produced online. **Battelle Columbus Laboratories,** 505 King Ave, Columbus, OH 43201.

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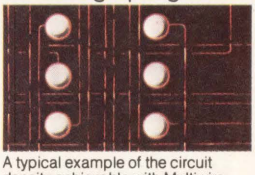


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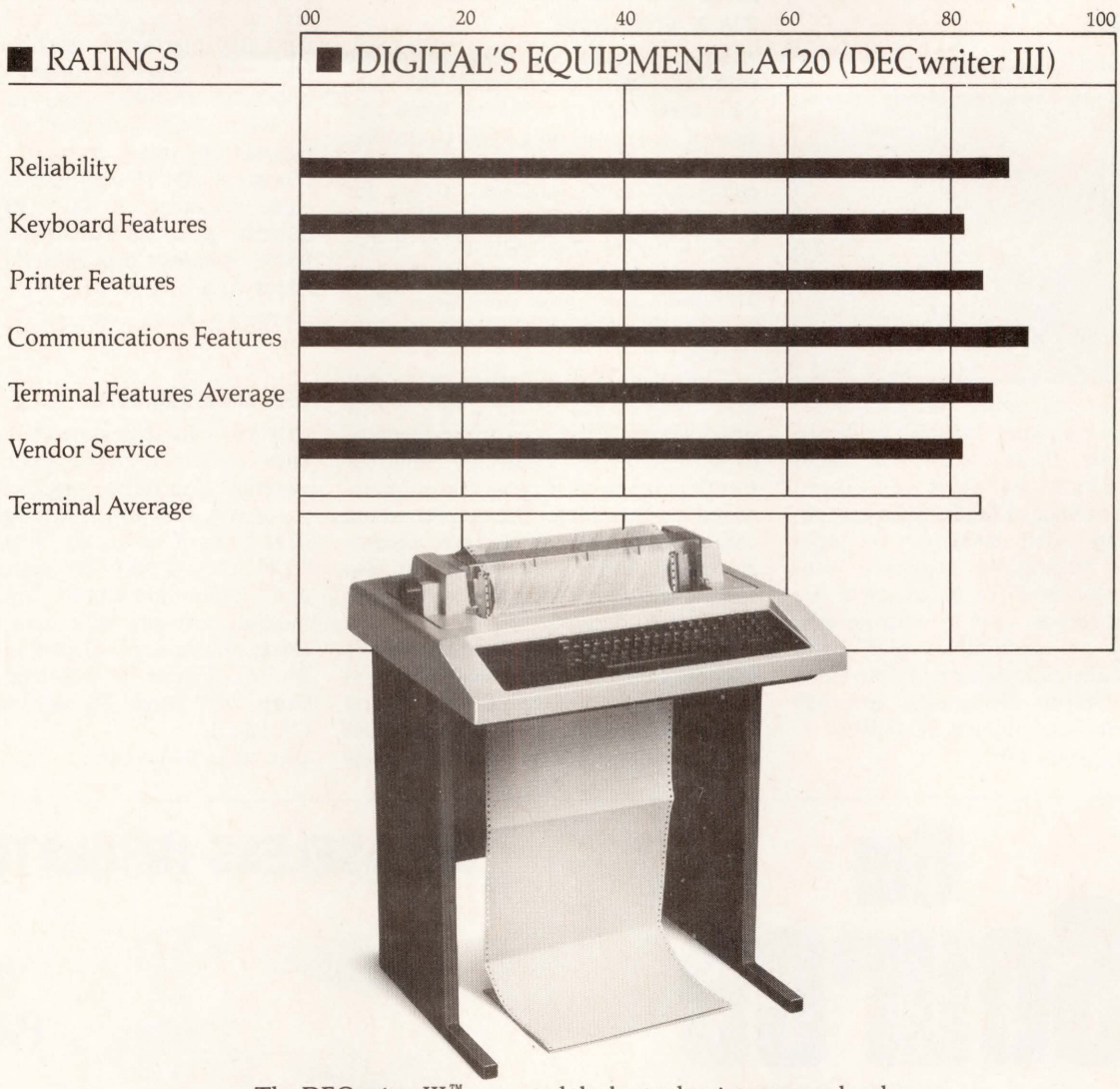
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Digital Equipment Corporation, Terminals Product Group, MR2-2/M67, One Iron Way, Marlboro, MA 01752. Tel. (617) 467-7068. In Europe: 12 Av. des Morgines, CH-1213 Petit-Lancy/Geneva. In Canada: Digital Equipment of Canada, Ltd.

*According to Data Decisions, Inc. For a copy of the survey entitled "Interactive Terminal Ratings," write to Data Decisions, Inc., 20 Brace Road, Cherry Hill, New Jersey 08034.

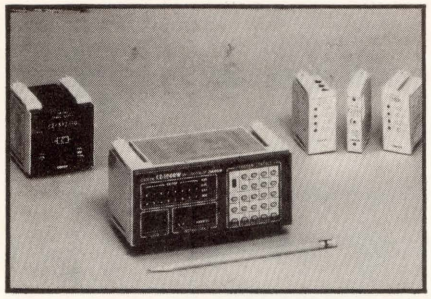
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INTERFACE

Programmable controllers



SYSMAC-MO miniature programmable controller combines integral keyboard programmer, display, and P/ROM loader in single 6″ x 3″ x 4″ (15 x 7.6 x 10-cm) package for logic or ladder diagram programming with RAM or UVPROM memory. SYSMAC-PO sequence controller, engineered for independent use or as an add-on unit to existing PCs, offers 24 I/O possibilities plus 2-and 3-unit parallel processing and distributed control. **Omron Electronics, Inc,** 650 Woodfield, Schaumburg, IL 60195.

Circle 378 on Inquiry Card

Large disc controller allows mix of drive types

A large disc controller designed for use with DEC PDP-11/70 computers, SC71 permits users to mix different types and sizes of disc drives on a single controller. The unit is functionally identical to the company's SC70 controller, except for the addition of a P/ROM that defines up to 32 different combinations of 4 disc drives. Model SC71/B1 emulates the DEC RH70/RM02, RM03, RM05 subsystem, while SC71/B2 emulates the RH70/RP06 subsystem.

Controllers are composed of 4 PCBs that reside in any of the CPU's 4 RH70 slots. Three of the boards are identical to those in the SC70 controller, while the fourth contains the P/ROM that supports mixed disc handling. The most common combinations of drives are preprogrammed into the P/ROM; users can also select their own configurations via option switch settings.

System features include an automatic self-test capability, extensive subsystem diagnostics in onboard firmware, and operating enhancements. Both modules execute standard DEC operating systems and diagnostic software, perform ECC and header CRC checks, and use standard SMD interfacing. All 4 drives can be integrated into a single subsystem, operating at serial data rates up to 10 MHz. Fully-buffered I/O circuitry permits operation at radial cable distances of 50′ (15 m) and daisy chain cable distances of 100′ (30 m). OEM quantity price for 100 or more units is $5088. **Emulex Corp,** 2001 E Deere Ave, Santa Ana, CA 92705.

Circle 379 on Inquiry Card

GPIB controller card

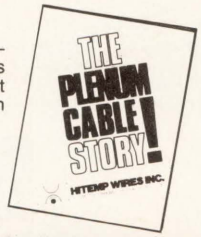
ZT7805 provides integrated CPU, memory, and I/O for GPIB equipped STD bus systems. Controller card includes 8085A processor, 1024 bytes of RAM and up to 8192 bytes of ROM, GPIB, (IEEE 488) I/O, 2 serial RS-232-C ports for system console and communications, and control monitor software with GPIB and RS-232 driver subroutines. Device is burned in for 168 h prior to shipment. **Zia Tech Corp,** 2410 Broad St, San Luis Obispo, CA 93401.

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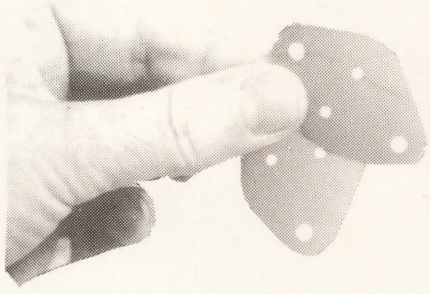
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CIRCLE 135 ON INQUIRY CARD

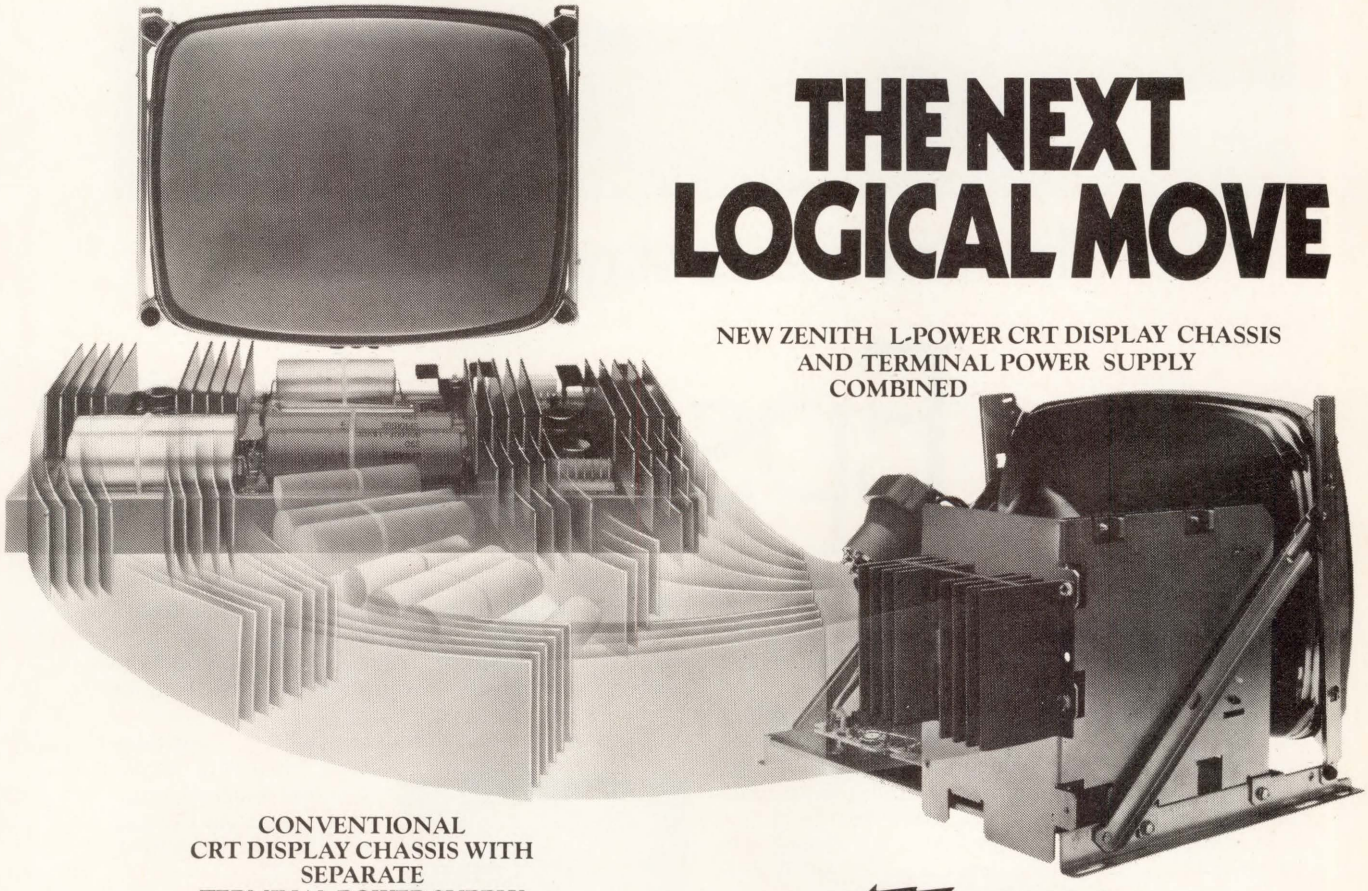
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Exclusive new Zenith CRT Display with L-Power for logic circuits means lower system cost.

This is no ordinary CRT Display. It also provides the power for your terminal logic circuits. This unique, scan-derived system replaces conventional power supplies, and results in CRT Display systems that are compact, uncomplicated, and have fewer parts. You get optimum reliability, a cooler-running terminal and lower system cost.

The Zenith CRT Display testing program subjects test units to thousands of hours, under extreme humidity, vibration, altitude, and temperature conditions. And exhaustive analyses of components and subassemblies, including electron microscope and thermograph scans in the Zenith Reliability Lab.

All Zenith CRT Displays: 5″, 9″, 12″, and 15″ are available with this innovative new L-Power system. For further information write: CRT Display Engineering Division, Zenith Radio Corporation, 1000 Milwaukee Avenue, Glenview, Illinois 60025, or call (312) 773-0074.



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NEW ZENITH L-POWER CRT DISPLAY CHASSIS AND TERMINAL POWER SUPPLY COMBINED

CONVENTIONAL CRT DISPLAY CHASSIS WITH SEPARATE TERMINAL POWER SUPPLY

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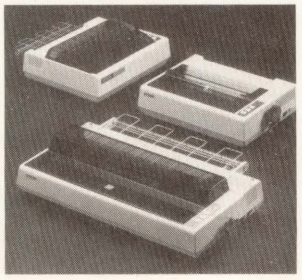
If you had a family like this, you'd be proud, too. All of them are sturdy, handsome young printers with the lowest out-of-box failure rate the world has ever seen. And one of them, our MX-80, is now the best-selling 80-column printer on earth.

Pretty impressive achievements for such a young family. But hardly surprising. They have just the traits you'd expect from Epson: unsurpassed reliability, correspondence quality printing, a logical seeking function and the famous Epson disposable printhead.

Our MX-80 F/T lets you print on single sheets, roll, or fan-fold and multi-part paper. Our MX-80 Type II has a built-in graphics capability. And our MX-82 gives you high-density graphics that can precisely place up to 10,368 dots in a square inch, making even accurate circles possible. Finally, our MX-100 gives you everything: a friction/tractor paper feed, graphics, and a 136-column format that accepts paper up to 15.5" wide.

All in all, there are a lot of reasons why your next OEM buy should be Epson. Because we're the world's largest, we can work with you on large quantities or specialized requirements. And because we make more printers than anybody, we can afford to sell each one for a little less.

But the best reason to buy our printers is our printers. They're a family that was designed, engineered and built to stay together. For a long time.



EPSON
EPSON AMERICA, INC.
OEM Products Division

3415 Kashiwa Street • Torrance, California 90505 • (213) 539-9140

CIRCLE 138 ON INQUIRY CARD

How does an OEM pick a daisy wheel printer?



By comparison. The OEM looks over each one and picks the printer that stands out because it has the low noise levels and quality his customers require, at the price they demand.

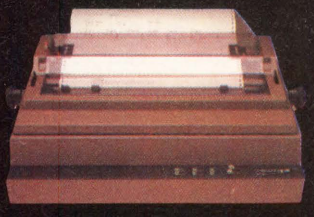
Olivetti OPE offers three low noise daisy wheel printers to pick from. DY 211, a 20 cps printer for low-end use; DY 311, with 34 cps for mid-range applications; and the high performance DY 811 with 65-80 cps.

The DY series of daisy wheel printers stands out with its exceptional print quality and its range of interfaces and accessories. The DY series is also available as print mechanisms with or without electronics.

Olivetti OPE also offers a complete line of thermal and dot matrix printers and printing mechanisms, and 5¼ and 8 inch Winchester and flexible disk drives.

For more information contact:

Olivetti OPE
505 White Plains Road
Tarrytown, New York 10591
(914) 631-3000
TELEX 429897



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CIRCLE 139 ON INQUIRY CARD

INTERFACE

Receiver/transmitter card

ISB-3720 provides interface between the company's STD BUS microcomputer system and remote data acquisition and control system (REMDACS); card allows for connection of up to 512 REMDACS stations to a STD BUS system. Onboard 8048 microprocessor performs serial to parallel to serial conversions and controls serial data protocol, transmission line synchronization, data transfers to and from onboard RAMs, serial data error checking, error flags, and interrupt generation. **Intersil, Inc,** 10710 N Tantau Ave, Cupertino, CA 95014.

Circle 381 on Inquiry Card

LSI-11 to IEEE-488 interface

GPIB11V-2 provides data transfer speeds up to 250k bytes/s while allowing 16-, 18-, or 22-bit addressing on the LSI-11 bus. All GPIB functions are provided. Interface allows LSI-11 to be connected with up to 14 GPIB compatible devices, and works in either single or multiple controller environments. Standard software package supports BASIC, FORTRAN, and MACRO callable subroutines under RT-11 and RSX-11 operating systems. **National Instruments,** 8900 Shoal Creek Blvd, Austin, TX 78758.

Circle 382 on Inquiry Card

STD BUS I/O timer counter board

STD-VI08 provides 8 programmable I/O ports, 64 individually programmable I/O lines, and 16 programmable handshake lines to permit high speed data transfers to peripherals. Four 16-bit timers permit wide range timing (2 μs to hours), automatic pulse output to an I/O line, and interrupt on timeout capabilities. Four 16-bit event counters monitor incoming I/O signals without CPU intervention. Std 50-pin headers provide connection to I/O devices. Price is $199. **Forethought Products,** 87070 Dukhobar Rd, Eugene, OR 97402.

Circle 383 on Inquiry Card

Intelligent diskette drive controller

Model 1180 is a single- (FM) or double-density (MFM) controller that operates with IBM Diskette 1 or 2D formats in single- or double-sided drives. Device controls up to 2 model 299B dual-head drives or 2 model 227 single-head drives. It allows data storage and retrieval at levels ranging from sector write/read to file management capabilities, and provides diskette initialization and diagnostic commands. **PerSci, Inc,** 12210 Nebraska Ave, West Los Angeles, CA 90025.

Circle 384 on Inquiry Card

Magnetic tape and disc controllers feature efficient architecture

A single-board embedded NRZI magnetic tape controller designed for use with IBM Series/1 computers, TC-110 is a complete NRZI controller formatter that interfaces the computer via the processor I/O channel. Capable of controlling up to 4 drives, the device can handle a mix of any 2 speeds from 25″ to 125″ (64 to 318 cm)/s and is completely operating system software transparent to the IBM 4969 magnetic tape subsystem. A second embedded phase encode board provides full dual-density capability.

DC-251, a single quad-board embedded SMD disc controller for use with DEC LSI-11 computers, mounts in any quad Q-bus slot and emulates the DEC RM02 disc subsystem with up to 2 drives. Each drive port has individual drive sizing switches that allow a mixed connection to drives having from 40M- to 675M-byte capacity. A 3-sector data buffer eliminates data late conditions, and an auto throttle feature prevents the controller from locking out other peripheral devices.

A high performance single-board embedded disc controller, DC-221, emulates Data General Zebra series disc subsystems; up to 4 drives, with capacities of 40M to 675M bytes each, can be connected to the controller. Depending upon the drive selected, the controller emulates and is software transparent to the Data General 6060, 6061, or 6067 disc subsystems, including diagnostics. Customer options include automatic alternate tracking and data strobe early/late. All controllers have extensive self-diagnostic capabilities. **Western Peripherals, Div of Wespercorp,** 14321 New Myford Rd, Tustin, CA 92680.

Circle 385 on Inquiry Card

5.25″ Winchester controller matches form factor of drive

Designed specifically for Seagate 5.25″ (13.34-cm) compatible drives, the S1410 controller is exactly compatible with Data Technology Corp's DTC 510 and Shugart Associates' SA 1400 series host interface, allowing it to operate with host adapters supplied by these companies. The controller's use of VLSI technology results in 55% fewer ICs (56) than the DTC 510 (125). Packed in a compact 5.75″ x 8″ (14.61- x 20-cm) board, the controller exactly fits the form factor of the 5.25″ (13.34-cm) drives.

Capable of controlling 2 drives simultaneously, the board combines a microprocessor based controller with onboard data separator logic and the Shugart SA 1400 series host interface. Commands are issued to the controller over an 8-bit bidirectional data bus connected through an adapter to the host computer. The controller features the OEM 32-bit polynomial error correction fire code that allows for up to 22-bit burst error detection and up to 11-bit burst error correction.

Standard features include automatic seek and verify, automatic head and cylinder switching, onboard full sector buffer, programmable sector interleave, variable sector size (256 or 512 bytes), automatic retries, and user programmable drive characteristics. Power requirements are 5 V at 2.5 A max, and 12 V at 50 A max. Single-unit price is $295. **Xebec Corp,** 432 Lakeside Dr, Sunnyvale, CA 94086.

Circle 386 on Inquiry Card

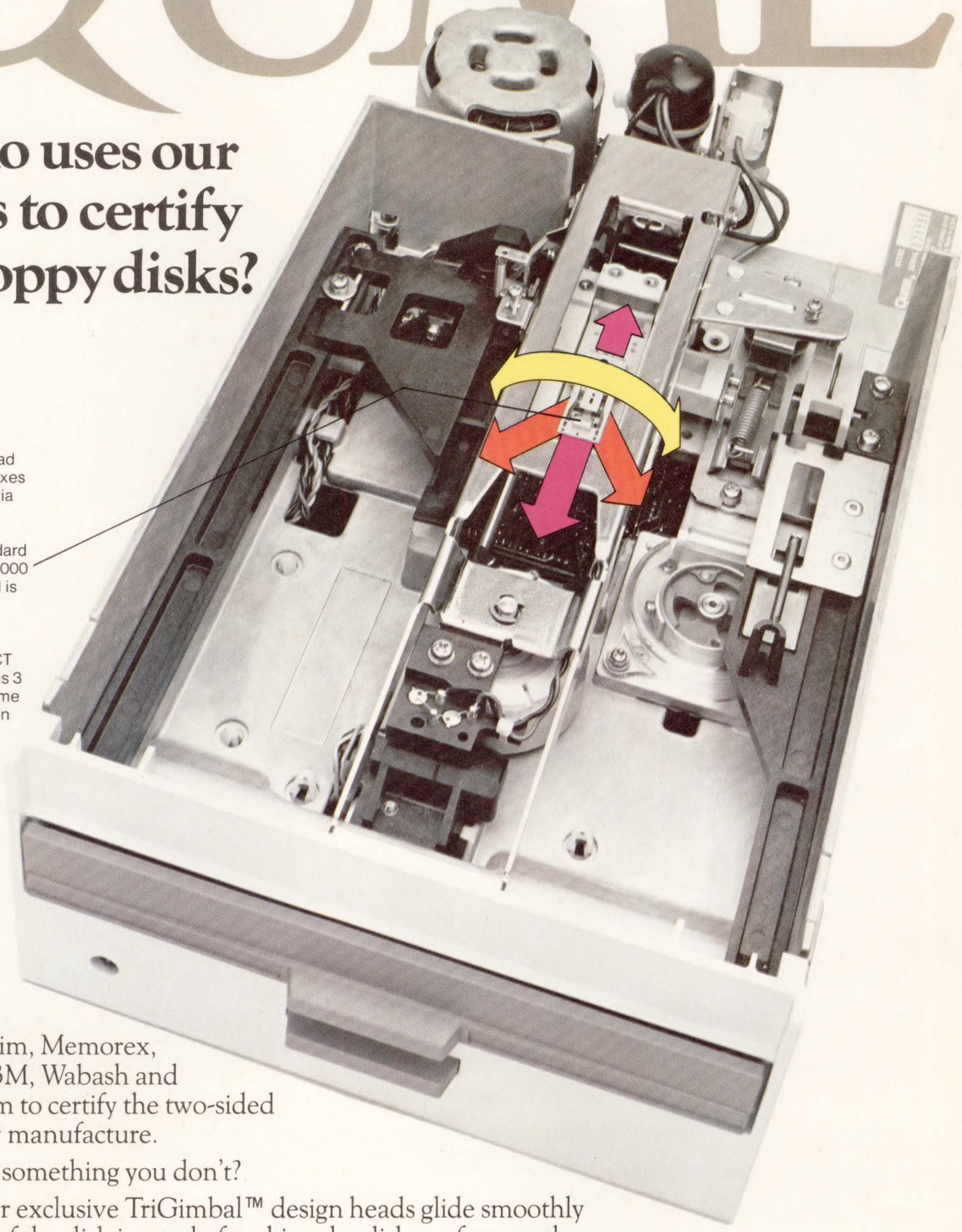
Bisync interface for LSI-11

RBT-11E™ remote bisync terminal package allows LSI-11 systems to communicate with systems supporting IBM 2780, 3780, 3741, or 2770 protocols. System offloads primary protocol and data management functions to Z80 based PCP-11E™ slave communications processor with resident protocol firmware, reducing host LSI-11 memory and processing overhead and increasing operating system independence. Package also includes operating system compatible device driver and user level terminal emulation software. Host software is distributed in source form and is supported under RT-11, RSX-11M, and RSTS/E operating systems. **Nortek, Inc,** 2432 NW Johnson St, Portland, OR 97210.

Circle 387 on Inquiry Card

QUME

Who uses our drives to certify their floppy disks?



ROLL, PITCH, and YAW: Exclusive TriGimbal™ head design rotates on three axes for a floating ride on media surface.

TAP TEST: Industry standard is a modest 25,000 to 30,000 impacts. QUME standard is an awesome 100,000 to 150,000 impacts.

CONTINUOUS CONTACT TEST: Industry standard is 3 to 3.6 million passes. Qume standard is 10 to 12 million passes.

ACCURACY: QUME drives have fewer seek/read errors due to improved head compliance to media surface.

Dysan, Verbatim, Memorex, BASF, Nashua, 3M, Wabash and CDC all use them to certify the two-sided floppy disks they manufacture.

Do they know something you don't?

They know our exclusive TriGimbal™ design heads glide smoothly over the surface of the disk instead of making the disk conform to the heads. We're proud of that, and it's a good example why Qume has installed more 8" double-sided floppy drives than any other manufacturer. For more information about the gentlest, most reliable drives on the market, call or write Qume Product Marketing (408) 942-4000, 2350 Qume Drive, San Jose, CA 95131.

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CIRCLE 140 ON INQUIRY CARD



The accelerating growth in modem technology at Universal Data Systems has now produced the Company's first 9600 bps unit on a super-compact OEM board. Occupying about 100 square inches of PCB space, this microprocessor LSI modem offers dramatic space savings for designers who wish to package data sets internally in microcomputers, minicomputers or interactive terminals. The traditional UDS economy and reliability are inherent in the new 9600 bps modem.

Contact UDS for complete technical details, or phone your UDS representative. Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Telephone: 205/837-8100.

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CIRCLE 141 ON INQUIRY CARD

"A computer system for analog measurement must be built from the ground up."

Fred Molinari, President

When analog capability is merely tacked onto a laboratory computer system, performance is predictably poor.

So when we designed LAB-DATAX, analog measurement was our primary goal.

As a result, LAB-DATAX is the highest performance microcomputer data acquisition system available today.

LAB-DATAX is designed to preserve signal integrity, eliminating noise and ground loops through a unique front connection panel.

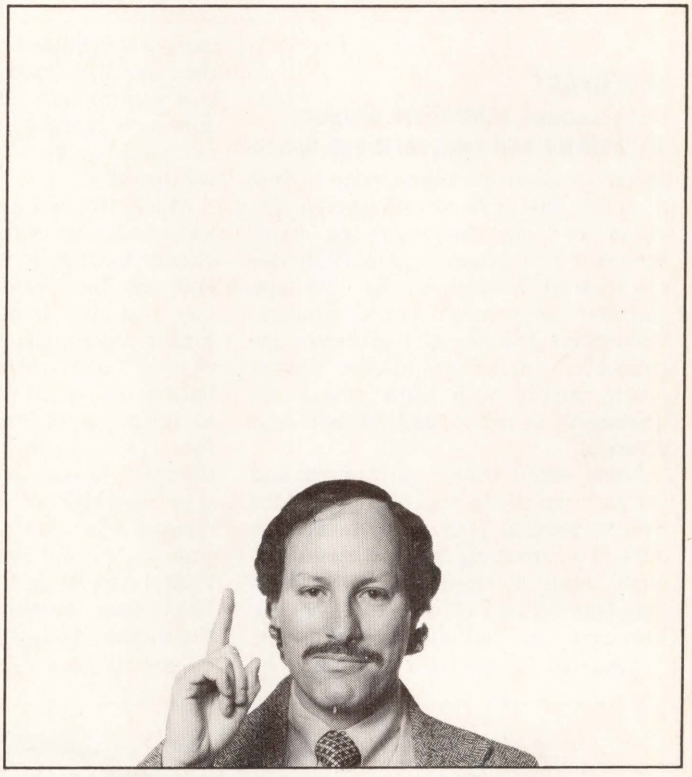
Analog problems such as wire paths, ground connections, and shielding have been met head-on and resolved.

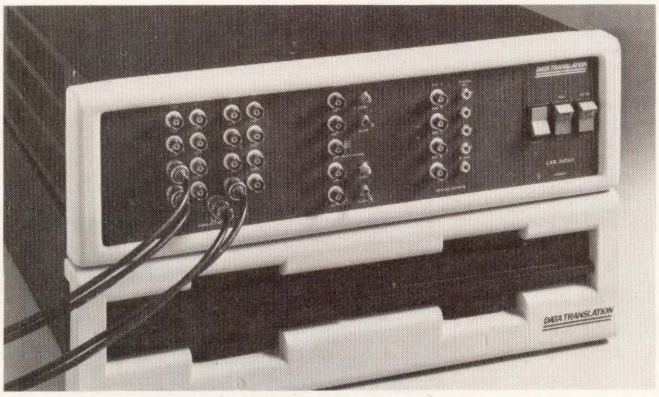
Throughput is extraordinary thanks to RT-11 FORTRAN IV software and our own DTLIB-FORTRAN callable subroutines.

In fact, the most powerful LAB-DATAX achieves continuous data throughput into memory at more than 62 times the rate of DEC's MINC-11.™

Most systems are constrained by their small selection of analog and digital I/O peripherals. They are limited in every way.

Not so LAB-DATAX. We offer you over 100 boards in configurations to ensure the performance you need.





Every model of LAB-DATAX includes an LSI 11/2™ CPU with 64KB RAM memory. A fixed and floating point instruction set. A synchronous serial interface. A bootstrap loader. A dual-drive double-density Floppy Disk. DTLIB-FORTRAN callable subroutines. And 16 slot dual-height capacity.

What's more, LAB-DATAX includes the full DEC RT-11 operating system. As well as a programmable real time clock, useful as a time base generator for analog conversions.

LAB-DATAX is even user configurable.

A broad array of analog input, analog output, and digital I/O is available for particular applications.

In all, LAB-DATAX is optimized for high performance in analog measurement. Optimized for high throughput, ease of use, and flexibility.

Proving once again that things always come out better when you start from scratch.

Data Translation, 100 Locke Drive, Marlboro, Massachusetts 01752. (617) 481-3700. Telex: 951646. In Europe: Data Translation Ltd., Rockwell House, 430 Bath Road, Slough, Berkshire/England SL1 6BB (06286) 3412. Telex: 849862.

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LSI-11 and MINC-11 are trademarks of Digital Equipment Corp.

CIRCLE 142 ON INQUIRY CARD

INTERFACE

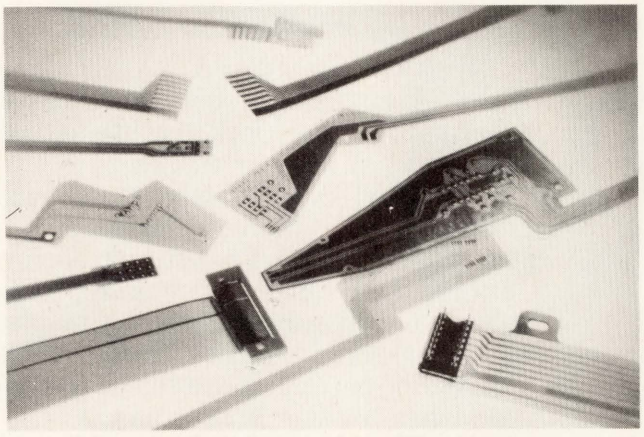
Dual-function controllers support Winchester and tape cartridge drives

Series 1400 controllers support up to four 8″ or 14″ (20- or 36-cm) Winchester disc drives and one tape cartridge drive. Standard host adapters simplify the integration of Winchester discs and tape cartridge with most microcomputers. Controllers feature microprocessor intelligence, single-board design, shared power supply with same power requirements as drives, and efficient host protocol.

Using serial tracks in forward and reverse directions (serpentine), controllers provide read or write backup data in a streaming mode without frequent starts or stops. Commands and data transfers are transmitted from the host over a bidirectional 8-bit data bus. Typical I/O requests are performed by passing a command description block to the controller. Backup functions include single-command disc save/restore, automatic tape read re-try on error, and automatic error correction on tape during disc save.

Model DTC-1406 uses two serial tracks and handles up to four 8″ (20-cm) Winchester drives using SA1000 type interface and one Data Electronics "Streaker" tape cartridge drive; DTC-1408 supports similar systems using an Archive "Sidewinder" tape cartridge drive. Typical backup time is 2.5 min. Model DTC-1407, using four serial tracks, supports up to four 14″ (36-cm) Winchester drives (Shugart SA4000) and one "Streaker" tape cartridge drive; model DTC-1409 replaces "Streaker" with "Sidewinder" support. Typical backup time is 5 min. Prices start at $1200 in quantities of 1000. **Data Technology Corp,** 2344A Walsh Ave, Santa Clara, CA 95051.

Circle 388 on Inquiry Card



FLEX CIRCUITS FOR DISK DRIVES, PRINTERS

- Single and double-sided designs
- Reduce assembly costs, inspection time
- Reduce interconnect weight and volume
- Improve wiring accuracy and circuit performance

From design to volume production, quality flexible circuitry from Buckbee-Mears Company

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NASHUA, NEW HAMPSHIRE 03060
(603) 883-5541

S-100 4-port serial I/O interface

Model 2710 permits independent programmable port control using four 8250 asynchronous communications elements. Each port has full handshaking and allows clock divisors from 1 to 65535 for baud rate control; 5-to 8-bit words; even, odd, or no parity; 1, 1.5, or 2 stop bits; and false start bit, parity, framing, and overrun detect. Device features 3 control registers, 3 status registers, and a 16-bit baud rate divisor latch at each port. **California Computer Systems, Inc,** 250 Caribbean Dr, Sunnyvale, CA 94086.

Circle 389 on Inquiry Card

RS-232 current loop interface

MINT-01 converts TTL voltages to single 20-mA current loop input and output, or to RS-232 inputs and 4 RS-232 outputs, selectable with onboard jumpers. Onboard dc-dc converter provides ±12 V for conversion circuitry, while requiring a 5-V input at 400 mA. Components and input connectors are mounted on one side, with a female 25-pin D type connector on the other. Mounting to chassis or back panel is accomplished by a std 25-pin D cutout. **Miller Technology,** 647 N Santa Cruz Ave, Los Gatos, CA 95030.

Circle 390 on Inquiry Card

DEVELOPMENT SYSTEMS

Disc based development system



MC-1 uses a ROM emulation technique to provide development support for any 2716 or 2732 based system. System includes 3-MHz Z80 processor, 48k bytes of RAM, two 640k-byte 5.25″ (13.34-cm) discs, emulation for two 2716 or one 2732 EPROM, CP/M 2.2 compatible operating system, editor, and macro assembler. Expansion boards extend emulation capacity to a total of six 2716 or three 2732 EPROMs. **Synapse Corp,** PO Box 1016, North Falmouth, MA 02556.

Circle 391 on Inquiry Card

CIRCLE 143 ON INQUIRY CARD



FILTER ADAPTORS FOR FCC TIGHT SPOTS.

FCC Docket 20780 says devices which use or generate RF energy in excess of 10 KHz must meet new conductive and radiated emission requirements.

How do you meet these requirements if you've already designed in an unfiltered D Sub connector for your I/O needs? Redesign the system? And wait for the job to be retooled and get into production?

You're talking time and money. A lot of it.

Fortunately, ITT Cannon has a better way. We have 25-pin filter-connector adaptors for your D Sub I/O needs. At a price you can live with.

The perfect adaptors for computers, RF power supplies, data transmission and telecommunications.

So call or write us today. We'll send out a sales rep with a sample adaptor you can plug right into your existing D Subs.

The kind of adaptor that can satisfy federal regulations and your small space requirements at the same time.

To get your sample filter connector, contact ITT Cannon Phoenix, a Division of International Telephone and Telegraph Corporation, 2801 Air Lane, Phoenix, AZ 85034. Telephone: (602) 275-4792. In Europe, contact ITT Cannon, Avenue Louise 250, B-1050 Brussels, Belgium. Telephone: 02/640-3600.

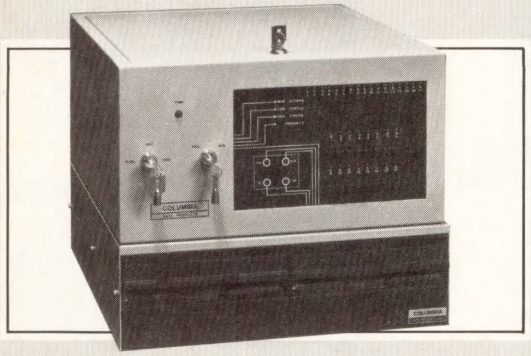
CANNON ITT

You can always connect with Cannon.

CIRCLE 144 ON INQUIRY CARD

When the Market Demands Performance

Why compromise your requirements to the limitations of a personal computer? Columbia Data delivers a full range of high performance microcomputer systems featuring unmatched capability, reliability, support and **real** economy.



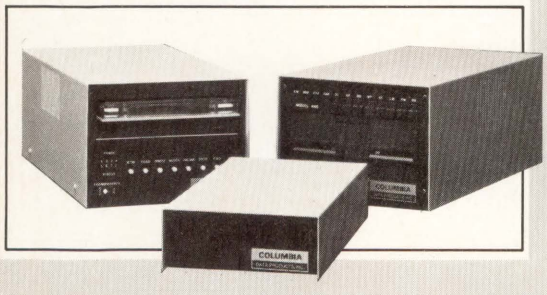
Multi-User Multi-Tasking Multi-Processor System
Affordable, upgradeable and expandable distributed processing is a reality with our new DC-1000 system. By simply adding satellite processor boards, our modular architecture allows for servicing up to 16 users, while creating a complete CP/M environment for each user; allowing full and fast execution of standard, unmodified CP/M programs. A master processor manages interaction of resources such as printers, floppy and Winchester disks, and data communication lines, at such speeds that a user is unaware others are sharing these peripherals.



Standalone Computer System With Graphics
With a Model 900 Commander Microcomputer, you don't need a separate graphics terminal . . . it's built in. You can display bar charts, histograms and complex point-to-point plots. And, because this Commander has an independent processor controlling the display, graphics can be handled without interrupting primary computing tasks. So . . . don't buy a graphics terminal . . . select a Columbia Data Products' Model 900 with the fullest I/O complement today, including RS-232, parallel, DMA and IEEE Bus controllers.



Floppy and Winchester Disk Based Computer Systems
Commander Series FX and MX computer systems let you connect your dumb terminal into a powerful distributed processing system. With these floppy disk based Z80A computers, you can perform a vast array of computer tasks using high-level language programs (such as BASIC, PASCAL, COBOL, and FORTRAN). Expandable versions are also available offering high performance Winchester disk storage and multi-user capability with up to 5 users sharing a 256K Z80A processor system running under CP/M and MP/M.



Intelligent RS-232 Storage Systems
These microprocessor-controlled data storage products offer cost effective storage with trade offs between capacity and access speed. In addition to the standard storage capabilities, these high-speed tape units, mini-floppy disks and data buffer units provide intelligent data handling, improved file management and editing as well as ease of operation . . . locally or remotely. Each data storage product is fully compatible with RS-232C/CCITT V.24 bus standards for data rates up to 19,200 baud.

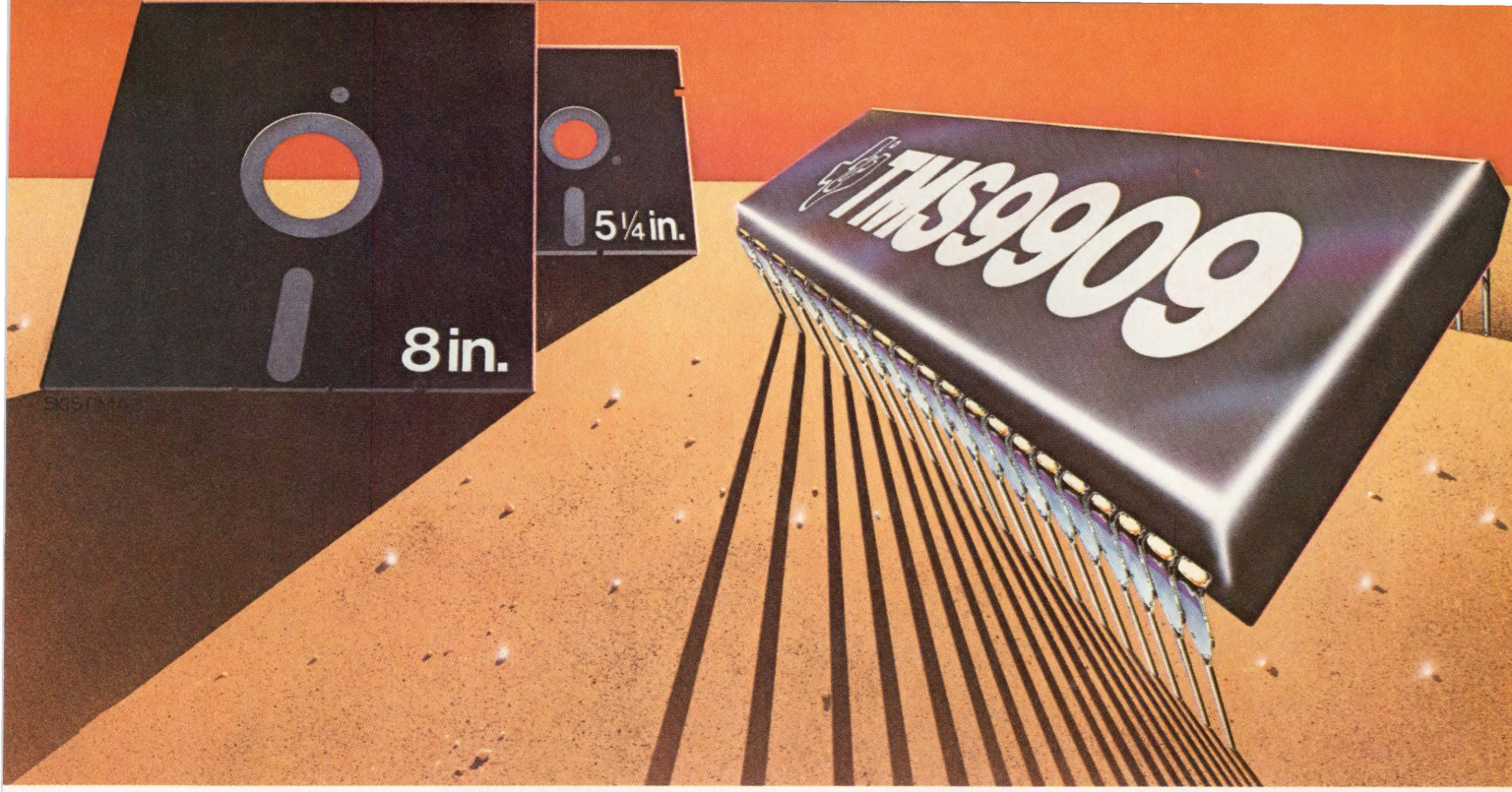
COLUMBIA
DATA PRODUCTS, INC.

Home Office:
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8990 Route 108
Columbia, MD 21045
Telephone: 301-992-3400
TWX: 710-862-1891

West Coast:
Columbia Data Products, Inc.
101 Scholz Plaza (Versailles)
P.H. 21
Newport Beach, CA 92663
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Europe:
Columbia Data Products (Europe)
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CIRCLE 145 ON INQUIRY CARD



The widest variety of programmable floppy disk functions available anywhere. TMS9909. New from TI.

Control any of today's floppy disk drives with TMS9909. Interface with any popular 8 or 16-bit microprocessor with TMS9909. Enjoy the widest variety of programmable disk functions available anywhere, from anyone, with TMS9909.

Advanced features

Like read from or write into partial sectors. Powerful features like simultaneous control of two different disks. Versatile features like read from or write into single or multiple sectors of both hard or soft disks. Programming features like a complete command library that provides for simplified processor control.

Format compatibility

TMS9909 is compatible with all data-recording formats used today — IBM single and double density and TI double density. Use TMS9909 with any of the frequency modulations data encoding formats — FM, modified FM or use the modified modified FM (M^2FM).

TMS9909 can support any combination of up to four different double-sided standard 8″ or 5¼″ mini disk drives. So, TMS9909 is compatible even when your disk systems aren't.

TMS9909—Key features

- Formats are totally user defined.
- Will run any floppy on market.
- Allows partial sector reads and writes.
- System hardware configuration doesn't have to change for different drives — only firmware changes are required.
- Makes controller standardization/retrofit possible.
- Seeks are done as an integral part of the read, write and format commands — can be executed separately.
- A system can be programmed to keep the head(s) loaded — ideal for double-sided drive users.

A single interface is all that you need thanks to a memory-mapped MPU interface which supports an external DMA interface. Sixty-four status error return codes simplify system error reporting and system diagnostics.

TI's on-chip clock generation logic keeps the parts count limited regardless of the programmed data rate.

Flexible, versatile, available

TMS9909 finds ideal application in word processing, business and industrial systems, as well as in personal computing systems.

The flexibility, capacity and parts reduction features provide you with a device with great promise... and a low price. Ask us for a quote today.

The TMS9909 is available now at your TI distributor or sales office. For more data, write to Texas Instruments, P.O. Box 202129, Dallas, Texas 75220.

Texas Instruments invented the integrated circuit, microprocessor and microcomputer. Being first is our tradition.

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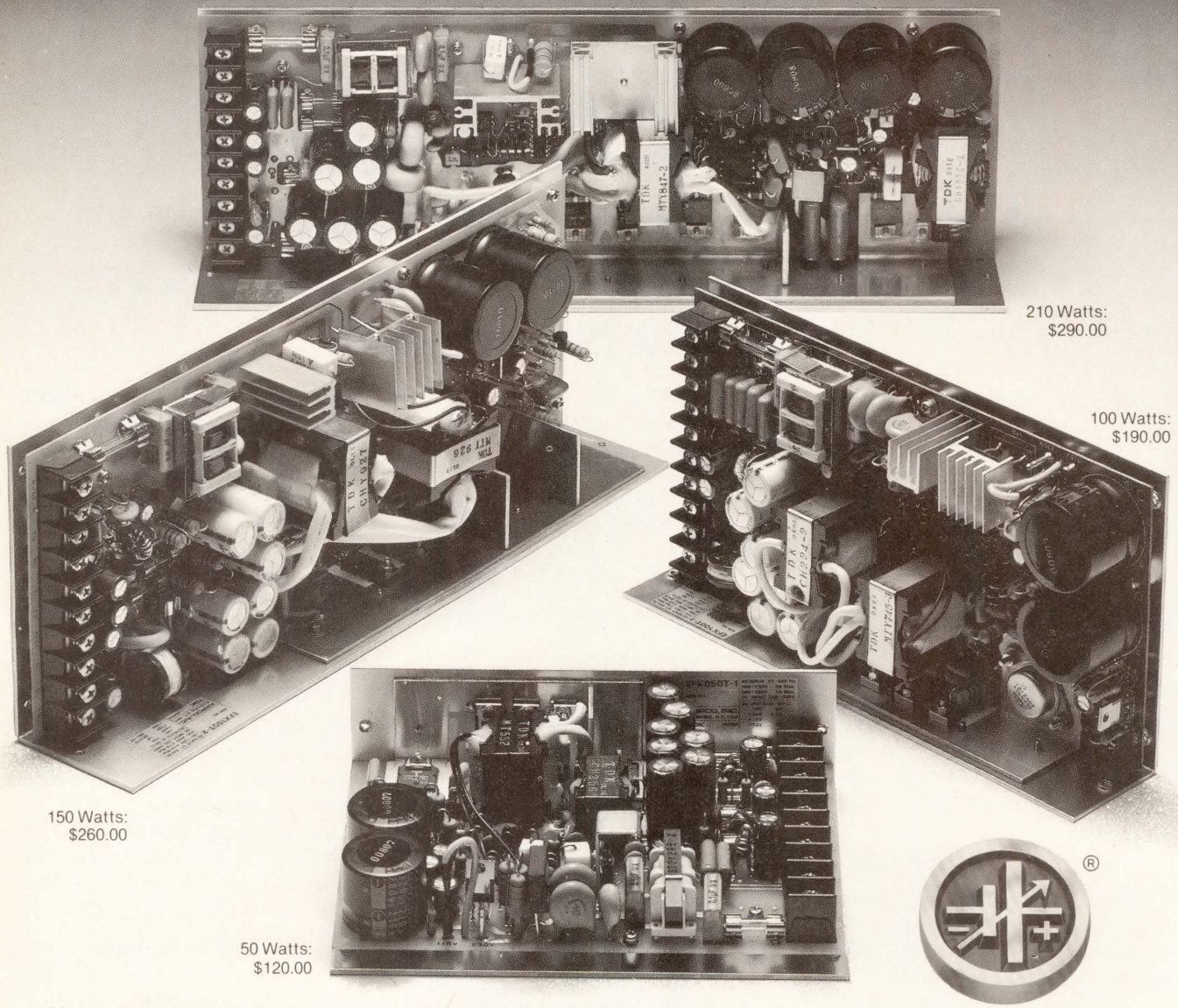
CIRCLE 146 ON INQUIRY CARD

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open frame SWITCHING POWER SUPPLIES

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210 Watts:
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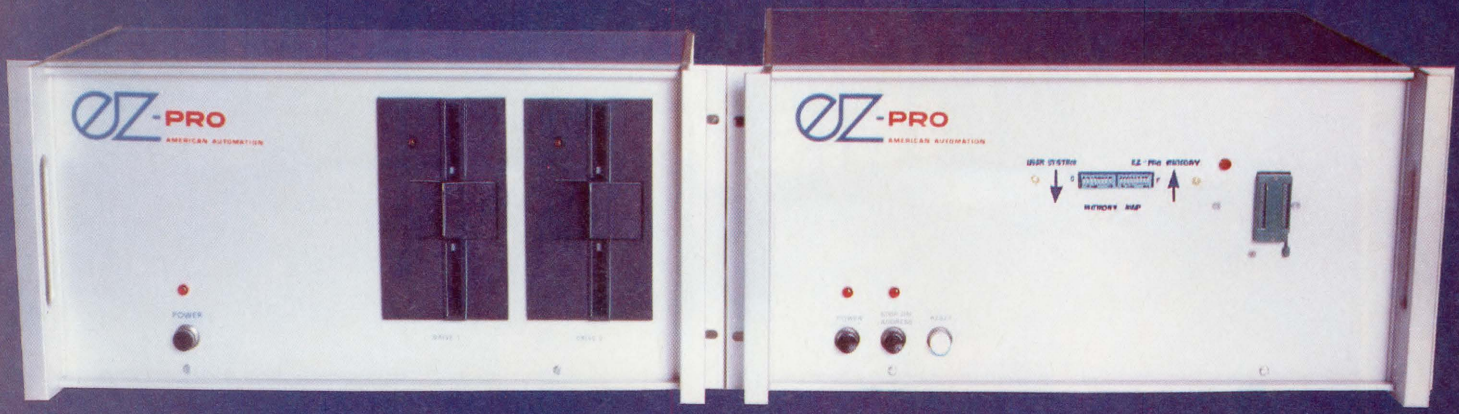
Single board, multiple-output, open frame switch-mode power supplies offer you high efficiency, well regulated power at a very attractive price.
The listed prices are for single unit quantities. Please contact us for quantity pricing and a demonstration.

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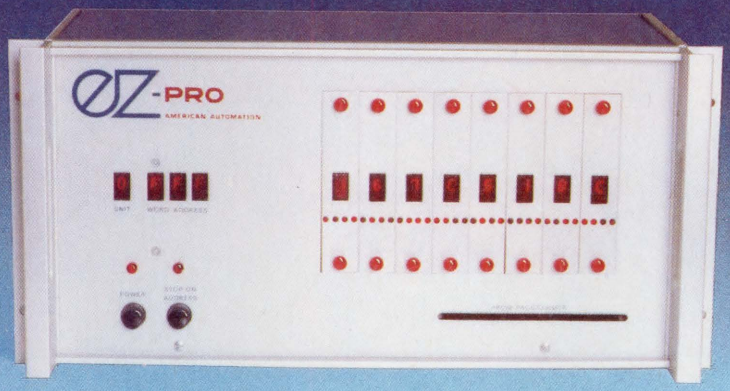
CIRCLE 171 ON INQUIRY CARD

The EZ-PRO Development System



AA-591
Dual Disk

AA-570
Basic Development
Unit



AA-580 Interface Module equipped with eight AA-582 Memory Modules — used with bit slice systems.

THE EZ-PRO SYSTEM FEATURES:

Fixed Word Length Processors

- EZ-PRO supports a bunch and the bunch is getting bigger fast. Right now it's the 2650, 8X300, Z80, Z8001/2, 6800, 6802/8, 6805/146805, 6809, 68000, 6502/12, 6503-15 family, 3870/2/4/6, 8080, 8021, 8085, 8048 family. All are supported with real time in-circuit emulators.
- Emulators — Master/Slave type — Every resource in each slave is available to the user system including all interrupts and stack pointers.
- Trace and Logic Analyzer capabilities of course.
- EPROM Programmer, 2716/32. Adaptor for 8748.
- Complete Software Support — Each emulator is provided with a Relocating Macroassembler, Linking Editor, Debugger and a DEMO program to show how the software is used. Higher level languages available include PASCAL and STRUBAL.

Bit Slice Processors

- EZ-PRO supports them all — You name it — 2, 4 or 8 bits wide — ECL or TTL.
- Microprogram word widths from 16 to 128 bits — Depths to 8K words.
- Bipolar PROM Programmers — ECL or TTL — 4 and 8 bit wide PROMs — intermixed if you like — Fast enough for production — Gang program 8 PROMS at a time with a single programmer.
- Complete Software Support — You'll have to experience it to believe the power and ease of use of AABASM, our Meta Assembler — And the rest of the software has the same standard of excellence.

The Basic EZ-PRO System

- 32 KB of static memory, expandable to 80 KB.
- Two RS-232 ports with selectable baud rates — one for a high speed printer and the other for a video terminal — Current loop port also provided.
- Choice of floppy disk capacities.
- Software provided for use on all systems includes a Resident Monitor, Disk Operating System, Disk Formatter and an Editor.

Prices

A complete EZ-PRO system equipped with one in-circuit emulator, dual disk unit, printer and video terminal sells for about $8,500. Bit Slice systems start at about $11,000.

What to do now that you're semi-sold . . .

Write or call us if you need more information. Then order a system at no risk. Advise us within 28 days of shipment from our plant that you don't want the system and return it to us in an undamaged condition within 35 days and we'll promptly return your money.

AMERICAN AUTOMATION
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CIRCLE 147 ON INQUIRY CARD

I'm not working for ITT DCD this year



"I'm taking the year off to write my doctoral dissertation, but I'm still on the payroll. ITT backs my efforts to get advanced degrees...it's their way of investing in people.

"As a matter of fact, I got my Master's thanks to ITT. Went to Polytechnic Institute of New York at night–not only did ITT pay for the tuition but they gave me a couple of hours off in the afternoon so I could make it to early classes. In 1973, I was a visiting student at Princeton, working towards my PhD in Physics full time. It was classes in the morning and work in the afternoon. Whatever I studied would come alive in solving the very real problems at work. Theory for breakfast and at the end of the day you get to create your own reality.

"It's like having a foot in two worlds–the academic world of pure science and ITT's applications oriented research. The view of both has helped me to see that industry can do exceptionally good science. The profit motive can be science's best ally. I always remember Dennis Gabor's remark when he got the Nobel Prize–that it was not just an award for him but the kind of science that gets done in industry. I've worked on everything from microphones to fiber optics, from undersea cables to spacecraft. When you put theory next to theory you never get to see the working parts. At ITT DCD, one part research and one part real world makes the perfect formula.

"The human dimension is very big around here. I seem to stop by the office even when I don't have to, simply because it's fun. It's friends that know what they're doing and what you're doing who are the best to talk to. And I like to bring the kids around for a picnic or a swim in the ITT DCD Clubhouse pool. I might be taking the year off, but I want to stay in touch with what's happening."

If you want to align your career with a company that looks for ideas and backs them all the way to reality, consider ITT DCD. We have openings for degreed engineering/scientific professionals at all levels of experience in the following areas:

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ITT DCD offers excellent salaries and a comprehensive benefits package that would be difficult to duplicate. Beyond medical, dental and life, we offer a superior system of educational support which encourages acquisition of credits and advanced degrees on our time at our expense. Relocation is another area of extraordinary effort on ITT DCD's part. We ease your move by coordinating all phases through our in-house relocation specialist. Please call or send resume to our Director of Professional Placement.

Where engineers never stop learning

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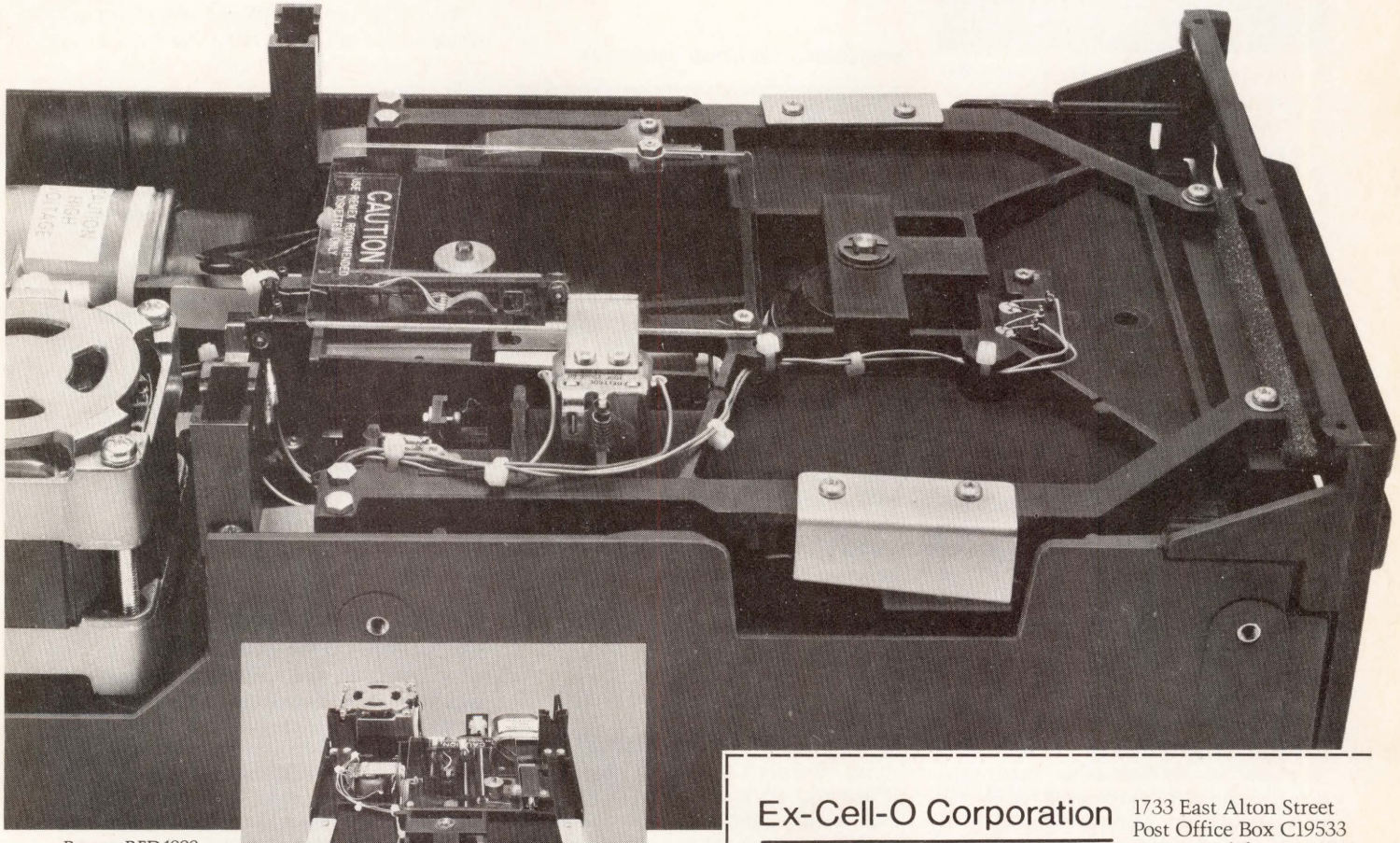
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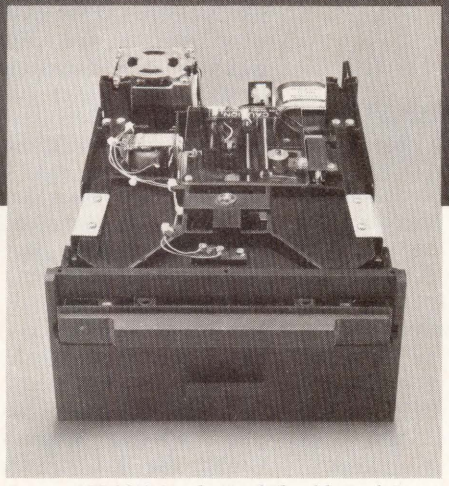
CIRCLE 148 ON INQUIRY CARD

Remex Dual Head Floppy Disk Drives.

No Extravagant Claims. Just Performance.



Remex RFD4000 Dual Head Flexible Disk Drive



Remex RFD2000 Single Head Flexible Disk Drive

Write or Call for Specifications and Delivery.

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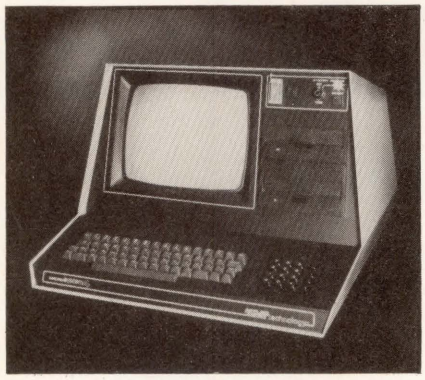
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Phone_____

CIRCLE 175 ON INQUIRY CARD

DEVELOPMENT SYSTEMS

Z80 development system is implemented in single package



A fully integrated STD-Z80 development system in the form of a CRT terminal, microsystem4 features I/O terminal, computer mainframe, and mass storage in a single package. The standard unit provides industrial and scientific users with a fully operational development system suited to a wide range of operating environments, including process control, word processing, data logging, engineering, and distributed processing. To increase system flexibility, all component circuit cards are STD BUS units and are directly transportable to the STD BUS target or application system.

Included in the system are a 4.0-MHz Z80 CPU, 60k bytes of program memory, 1M byte of double-density floppy disc storage, Hall effect keyboard, serial RS-232-C and programmable parallel I/O, and a choice of either CP/M® 2.2 or AForth™ disc operating systems. The 800-line resolution CRT features programmable attributes for each character, including reverse/normal video, underscore, blink, and half/full intensity. Two EPROM-resident 7 x 12 char sets are provided with each system. A 16-position rackmountable card cage can be completely removed from the unit and placed alongside for ease of access during developmental and prototyping applications.

System options include 5.25″ (13.34-cm) hard disc, joystick, alphanumeric keypad, and EPROM programmer panel. The system is priced at $4980 in unit quantities. **Applied Micro Technology, Inc,** PO Box 3042, Tucson, AZ 85702.

Circle 392 on Inquiry Card

STD BUS development systems

ISB80DS-3020 (Z80® based) and ISB85DS-3030 (8085 based) offer choice of either ISB-3100 or -3110 CPU card, plus floppy disc controller card, 64k dynamic RAM card, 3-port parallel I/O card, dual-channel synchronous/asynchronous communications card, and 16-slot card cage. Other features include switching power supplies and front panel ZIF socket for EPROM programming option. Systems are fully supported by ICP/M operating system, 8085/Z80 relocatable macro assembler, and I/O handlers. **Intersil, Inc,** 10710 N Tantau Ave, Cupertino, CA 95014.

Circle 393 on Inquiry Card

Standalone 6809/8048 emulators



Providing realtime emulation capabilities that are totally transparent to the target microprocessor system, EM-189 supports Motorola's 6089 series and EM-149 supports Intel's 8048/8049/8050 family. Both emulator and logic state analyzer are supplied in single unit. Tract memory captures the last 255 qualified machine cycles in 32-bit words. Mappable overlay RAM allows quick program change and execution. The 8048 series unit also traces I/O port activity. **Applied Microsystems Corp,** 11003 118th Place NE, Kirkland, WA 98033.

Circle 394 on Inquiry Card

Microcomputer system analyzer

RD-920 features 16k-byte RAM, RAM debugging, standard RS-232-C and TTL level serial interface, and standard parallel interface for PTR. Functions include memory read and program; OUT and IN commands; register read/write; programming load through PTR; transfer of RAM into P/ROM programmer; and interface with CRT, TTY, or terminal equipped with PTR or PTP. Device measures 420 x 390 x 180 mm and weighs 8 kg. **Intertek, Inc,** Naito Bldg, 7-2-8 Nishishinjuku, Shinjuku-ku, Tokyo, Japan 160.

Circle 395 on Inquiry Card

MEMORY SYSTEMS

Nonvolatile 16k-word memory includes battery backup

A 16k-word x 16-bit nonvolatile CMOS RAM memory board that plugs directly into a single slot of the DEC LSI-11 backplane, model 1816 CMOS-16 features an onboard battery that maintains data in memory during power outages or equipment shutdown for up to a full 168-hour week at 25 °C. When normal power is applied, onboard automatic switching and recharging circuitry keeps the two self-contained nickel cadmium batteries charged to peak efficiency.

The high speed (450-ns) RAM can reside in a contiguous block starting at any 4k-word address boundary within a 128k-word address space. It is logically divided into four 4k-word blocks, each of which can be write protected in 4k-, 8k-, 12k-, or 16k-word segments, via configuration switches. These switches are accessible even when the board is plugged into the rack; therefore, it is not necessary to remove the card in order to invoke write protection.

Power consumption is 5 W typ, and operating temperature is 0 to 55 °C. The board measures 8.5 x 5.0 x 0.375″ (21.6 x 12.8 x 0.953 cm) and is priced at $1295 in single units. A depopulated, 8k-word version, model 1816 CMOS-8 is available for $795. **ADAC Corp,** 70 Tower Office Pk, Woburn, MA 01801.

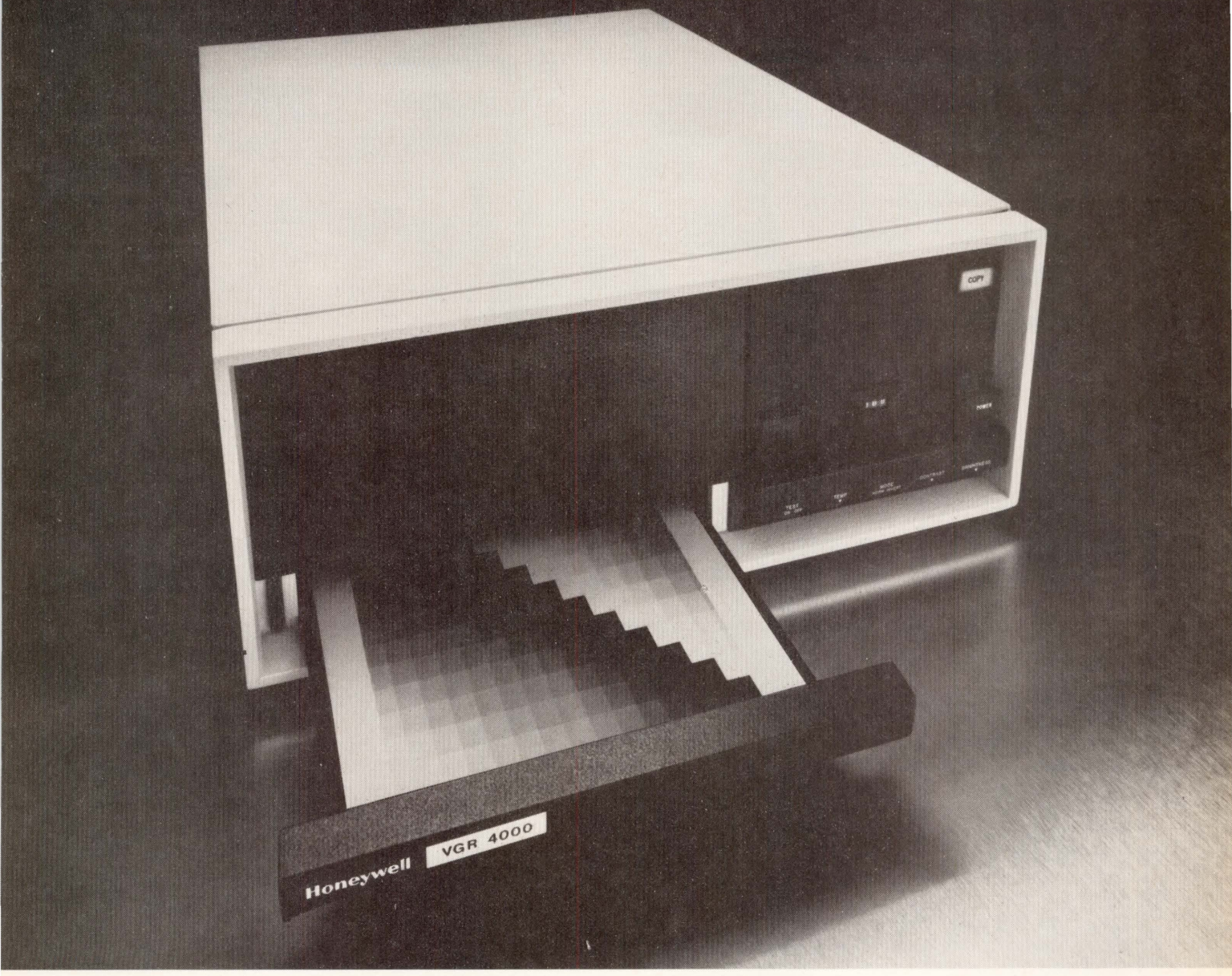
Circle 396 on Inquiry Card

Multibus memory boards

PSM 512 offers 0.5M bytes of RAM with error detection and correction circuitry on one board and operates in 8- or 16-bit mode. Versions are available with or without ECC, depopulated to 384k, 256k, and 128k bytes. PSM 064, providing 64k bytes of dynamic RAM, is 8- and 16-bit compatible and available depopulated down to 16k. PSM 6463 offers 64k bytes of nonvolatile CMOS RAM with onboard battery backup; 16k and 32k depopulated versions are available. PBM 80M, consisting of controller board handling 1 to 8 storage boards, provides bubble memory in 256k-byte increments up to 2M bytes. Software handler is supplied. **Plessey Microsystems,** 19546 Clubhouse Rd, Gaithersburg, MD 20760.

Circle 397 on Inquiry Card

THE LATEST ADVANCE IN VIDEO GRAPHIC HARD COPY RECORDING FROM HONEYWELL



VGR 4000, Honeywell's new and advanced video graphic recorder, provides fast, crisp, 8½ x 11" hard copies on dry silver paper from most CRT's and other video sources.

White-on-black or black-on-white images are as simple as flipping a switch. With options, images can be produced having up to 16 shades of grey or even more.

An innovative processing technique eliminates the need for large heated platens. This allows the recorder to run cool, consuming very little energy.

The VGR 4000 is the only recorder on the market available with a self-contained test-pattern generator providing a choice of formats for proper copy verification.

Rugged, yet cleanly designed for easy operation, the compact VGR 4000 can be used on a desk top or rack-mounted, taking up only 7" of front panel space.

Honeywell's VGR 4000 is the latest advance in video-input hard-copy reproduction systems, built by the people with the most fiber-optic CRT recorder experience in the field.

To get the whole story on the VGR 4000 and how it can meet your needs, call Durke Johnson at 303/773-4700. Or write Honeywell Test Instruments Division, Box 5227, Denver, Colorado 80217.

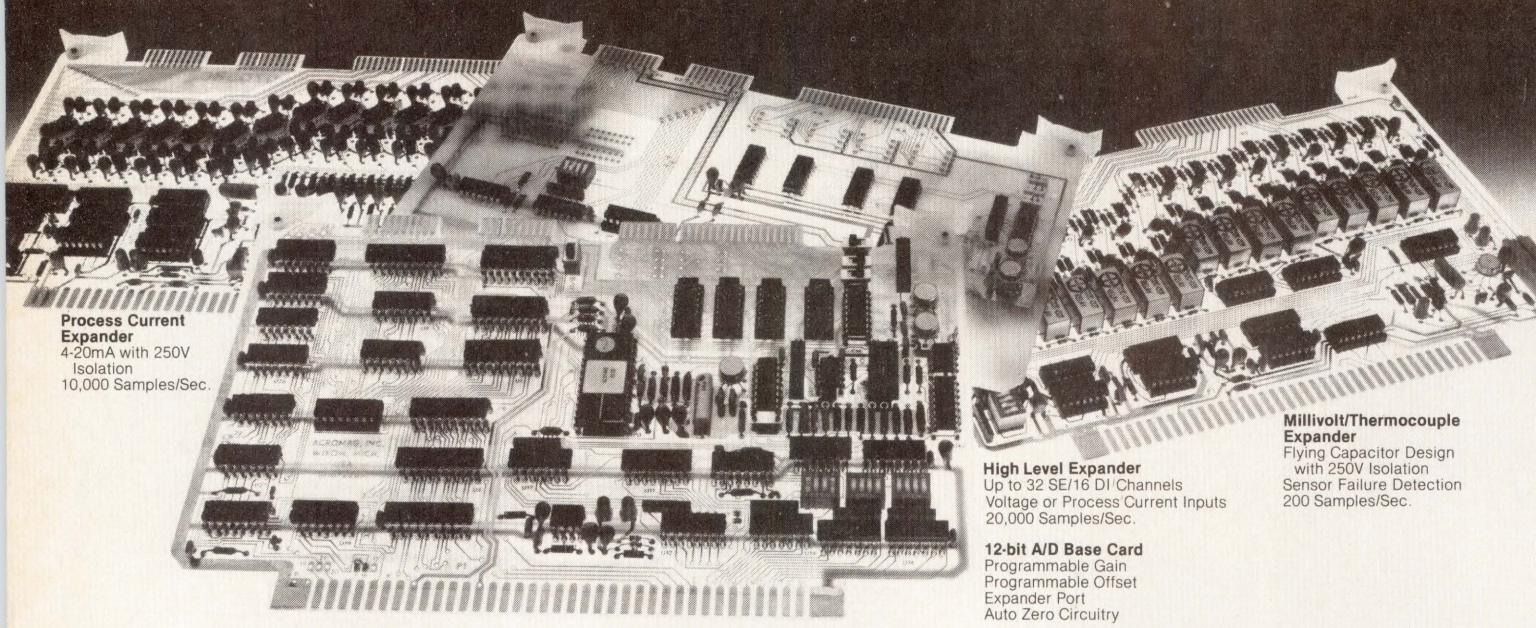
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CIRCLE 151 ON INQUIRY CARD

New! For Motorola EXORciser users.*



Process Current Expander
4-20mA with 250V Isolation
10,000 Samples/Sec.

High Level Expander
Up to 32 SE/16 DI Channels
Voltage or Process Current Inputs
20,000 Samples/Sec.

12-bit A/D Base Card
Programmable Gain
Programmable Offset
Expander Port
Auto Zero Circuitry

Millivolt/Thermocouple Expander
Flying Capacitor Design with 250V Isolation
Sensor Failure Detection
200 Samples/Sec.

Marries your micro to real world analog signals.

Here's the easy way to get your micro to accept industrial analog signals: Acromag's new Series 6800 Industrial Data Acquisition A/D Subsystem. It's compatible with the Motorola EXORciser bus and real world signals. Even in the presence of ground loops.

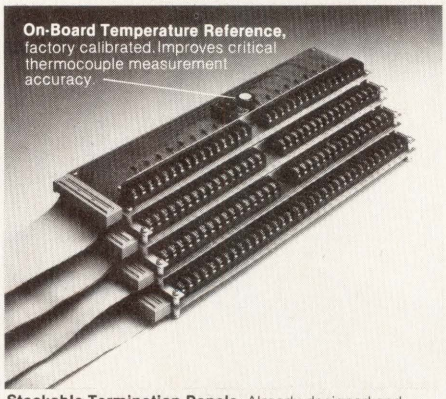
Our exclusive programmable offset feature gives resolution approaching that of a 14-bit system, with the speed and economy of a 12-bit.

Expands to 256 input channels (voltage, thermocouple and 4-20mA inputs) with only one base card.

Accepts any thermocouple input directly.

Thermocouple temperature reference on field wiring panel makes system independent of thermocouple type.

Auto zero feature improves accuracy over 0-70°C operating range.



Stackable Termination Panels. Already designed and built. So you don't have to do it. Industrial screw terminals provide practical solution to field wiring. Stacking feature saves space, simplifies later field expansion.

Powerful programming capabilities. Memory-mapped I/O with Auto Scan (and more).

Thermocouple linearization routines and software drivers available for fast system implementation.

The Series 6800 system's cards are electrically and mechanically compatible with the EXORciser bus. Just plug them in.

The 6810 base card includes a high speed 12-bit converter, programmable offset, programmable gain, external trigger and EXORciser bus interface/control logic.

Voltage, thermocouple and 4-20mA inputs are routed to appropriate expander cards where primary input filtering and signal conditioning take place. Expander cards may be mixed and matched for specific applications and do not present a bus load to the system.

For further details, call your local Acromag rep. Or write for Series 6800 packet. We'll also include a copy of our framable "Murphy's Laws of Instrumentation"...from the people who beat these laws with over 20 years of analog signal conditioning experience. Acromag, 30765 Wixom Road, Wixom, MI 48096. Ph: (313) 624-1541.

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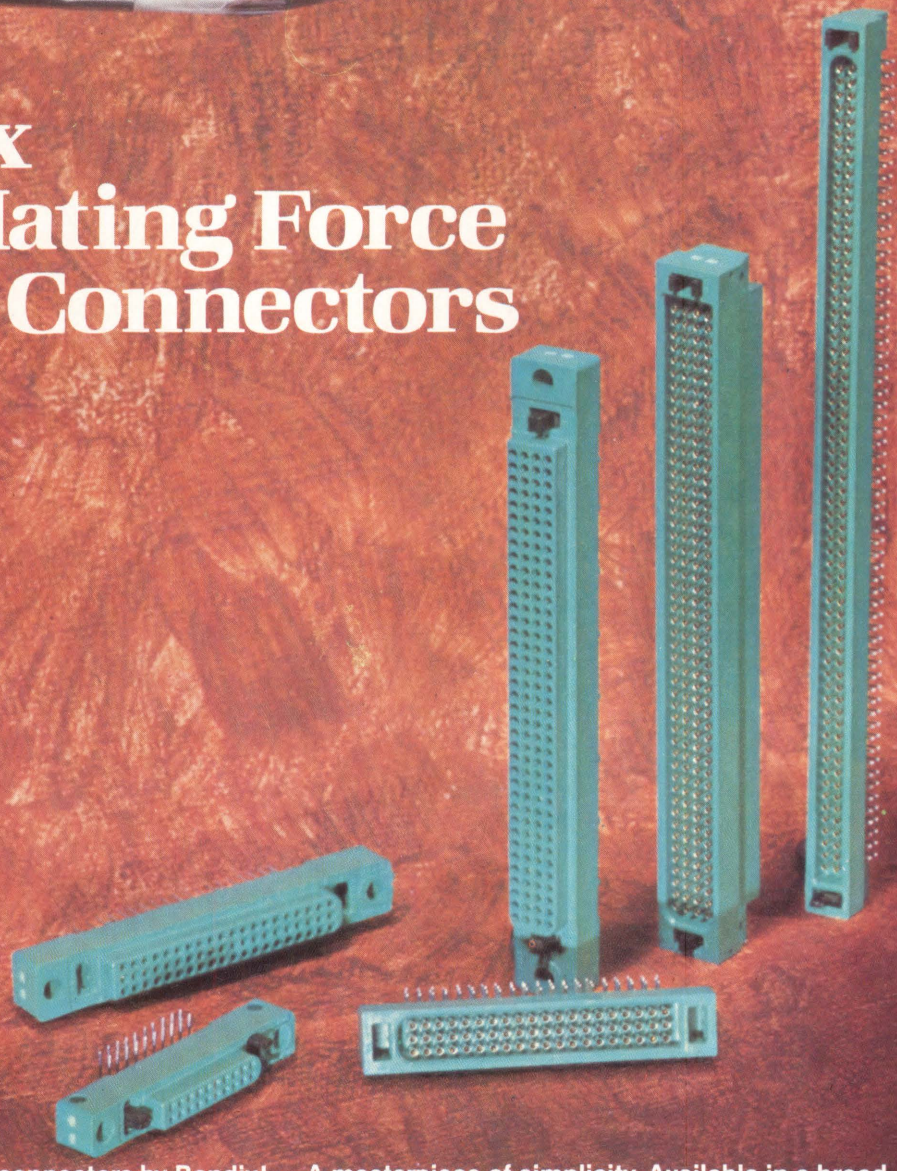
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CIRCLE 152 ON INQUIRY CARD

The state-of-the-art in PC design...

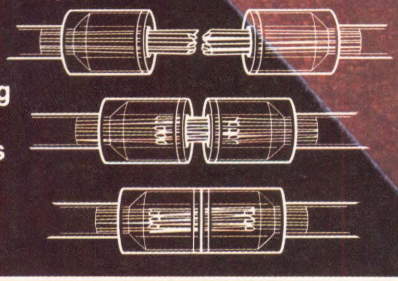
Bendix Low Mating Force Brush Connectors



Low mating force, bristle brush connectors by Bendix! They've advanced PC design to a new state-of-the-art!

A connector that's *dependable* (stable contact resistance), *durable* (up to 20,000 mates/unmates), *flexible* (20 - 400 contacts per connector), and *smooth* (mating force reduced by 70 - 90%)!

The brush "wiping" action of gold-plated wire bristles, meshing at highly redundant contact sites, creates multiple electrical paths, and intimate, gas-tight connection.



A masterpiece of simplicity. Available in a broad variety of connector/termination formats.

- compatible with High Speed Digital Switching
- greater board effectiveness by allowing more circuits per board
- stable electrical performance
- less need for exterior board supports
- no need for secondary activation procedures, typically required for zero-insertion force connection

That's the "broad brush" picture on our brush connectors. Get all the fine details in our new brochure, *LOW MATING FORCE.* Call 607 563-5302, or write The Bendix Corporation, Electrical Components Division, Sidney, New York 13838.

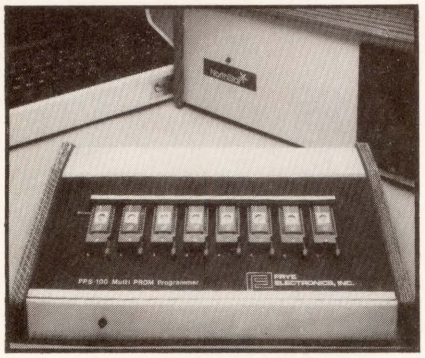
We speak connectors.

Bendix

CIRCLE 153 ON INQUIRY CARD

MEMORY SYSTEMS

P/ROM programmer handles 8 devices simultaneously



PPS-100 multi-P/ROM programmer interfaces with an S-100 computer using a 5.25″ (13.34-cm) dual-density, flexible disc drive and operating under CP/M. Up to 8 P/ROMs can be programmed simultaneously, each with different data. Most P/ROMs containing up to 64k bits can be programmed directly for either 8- or 16-bit applications. Personality modules are not required; the program is configured for various devices by entering the P/ROM type on the control terminal. Sockets are automatically configured for 24 or 28 pins upon selection of P/ROM types, and each socket can be independently mapped to any part of the available RAM memory.

A programming module, circuit board to plug into a Z80 or 8080 computer, connecting cables, and operating software on a flexible disc make up the system. Since all P/ROM data are stored on disc, (up to 65k bytes of storage/diskette), entire programs requiring up to 8 P/ROMs can be produced with a set of simple commands controlling the programmer. Mnemonic commands provide functions to input and display P/ROM data in hex and ASCII formats; manage the disc based library of P/ROM data files; read, program, and verify P/ROMs; and input, edit, and assemble programs. A "help" feature provides an online explanation of each command. Editing and reprogramming are accomplished with software provided.

The P/ROM programmer with software is priced at $2500. A total ready-to-use system consisting of programmer, North Star Horizon dual-disc drive computer with 32k bytes of memory, and a Soroc IQ 120 terminal is also available. **Frye Electronics, Inc,** 9826 SW Tigard St, Tigard, OR 97223.

Circle 398 on Inquiry Card

Solid state memory system

MINIMEG™ provides controller and up to 2M bytes of memory on an industry std 15″ x 15″ (38- x 38-cm) board. It functions as a cache to store frequently used data, and quickly transmits that data in and out of main memory. Features include full error correction, write protect function, full DMA transfer rates of up to 2.5M bytes/s with no latency, and "C" register that permits partial sector transfers. **Integrated Digital Products,** 3150 E La Palma Ave, Unit D, Anaheim, CA 92806.

Circle 399 on Inquiry Card

Multibus compatible memory board

MM-8086D, compatible with 8- and 16-bit microprocessors, features 32k to 512k bytes of memory on a single board, using 64k-byte NMOS dynamic RAMs. Designed 16-bits wide for compatibility with the iSBC 86/12A single-board computer, memory can be accessed in both bytes and words to provide compatibility with 8-bit processors. Cycle time is 400 ns and access time is 250 ns. Even parity is provided with output selectable to any interrupt. **Micro Memory Inc,** 9434 Irondale Ave, Chatsworth, CA 91311.

Circle 400 on Inquiry Card

Semiconductor add-in memory

PINCOMM 24S memory modules provide up to 1024k bytes of storage capacity on single card, are hardware and software compatible with DEC PDP-11/24 minicomputers, and are equivalent to DEC type MS-11L (M7891) memory. They are available in 512k-, 256k-, and 128k-byte increments. Memory organization is 18-bits wide, consisting of two 8-bit data bytes plus 2 byte-parity bits. Features include online/offline switch, 2 spare onboard RAMs, and LED indicators. **Trendata Corp,** 3400 W Segerstrom Ave, Santa Ana, CA 92704.

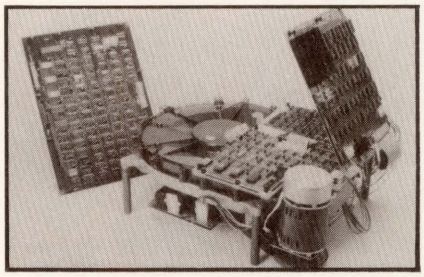
Circle 401 on Inquiry Card

128k x 9 memory module

Designed for Intel's Intellec® SBC 86/12A microcomputer, CI-8086 is available with 32k to 512k x 9 bytes on a single board. Device is compatible with 8- and 16-bit MULTIBUS® based systems and plugs directly into the system's backplane. It generates and checks even parity with selectable interrupt on parity error and allows maximum processor throughput with use of onboard refresh control logic. Data access time is 250 ns and cycle time is 375 ns. **Chrislin Industries, Inc, Computer Products Div,** 31352 Via Colinas #102, Westlake Village, CA 91361.

Circle 402 on Inquiry Card

160M-byte Winchester disc drive



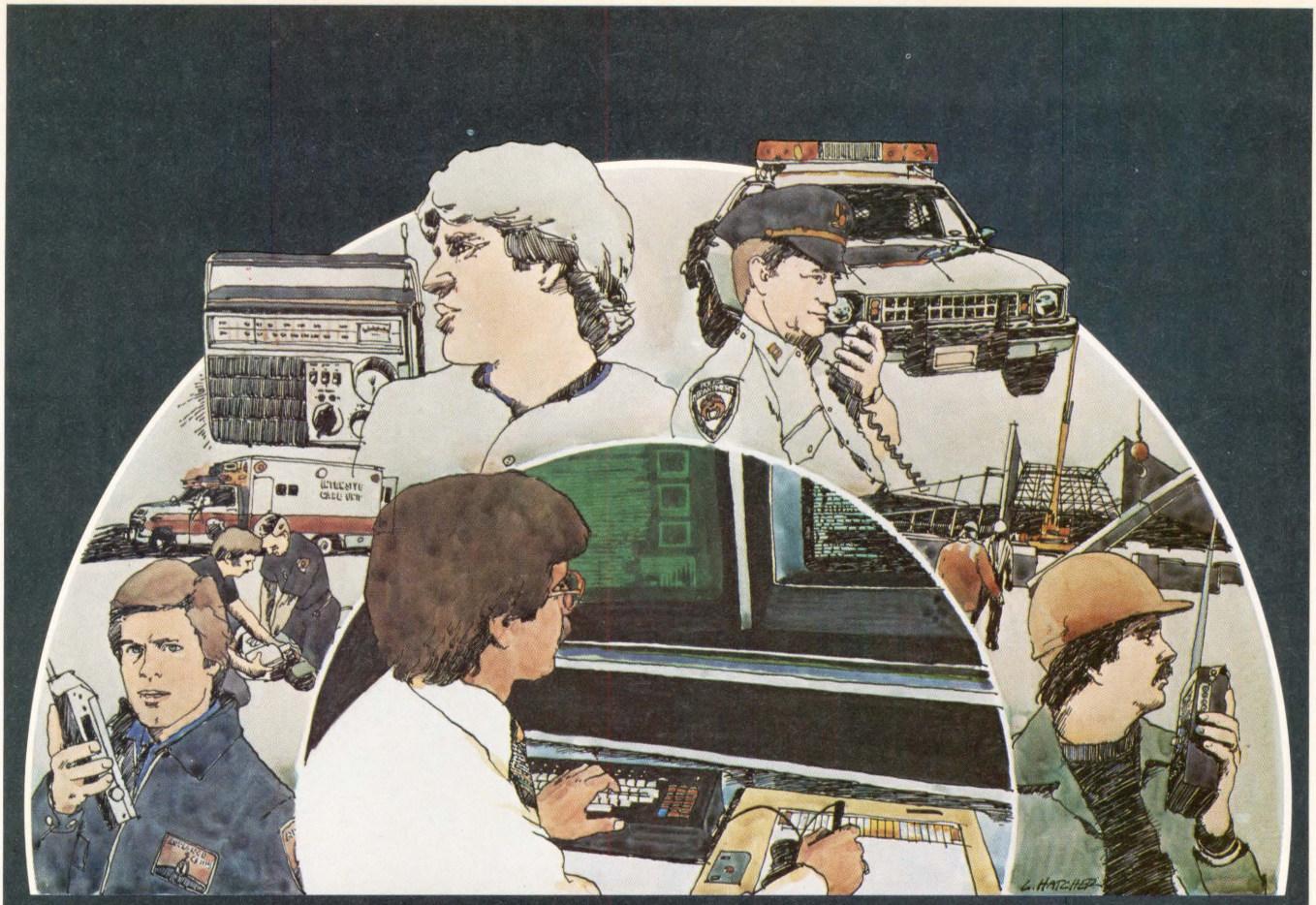
Marksman M160 features track density of 712 tracks/in (280/cm), bit density of 10,000 bits/in (3937/cm), and composite head composed of narrow ferrite core surrounded by calcium titanate slider material. Data transfer rate is 1280k bits/s, average seek time is 50 ms, and average latency time is 12.5 ms. Interface can be Marksman bus or storage module (SMD); Intelligent Marksman interface is optional. **Century Data Systems, A Xerox Co,** 1270 N Kraemer Blvd, Anaheim, CA 92806.

Circle 403 on Inquiry Card

Large capacity MOS RAM modules

Using 64k-bit MOS RAM technology, 128k-byte MSV11-LF and 256k-byte MSV11-LK single-board modules for LSI-11/23 microcomputers feature byte parity, onboard refresh capability, and either 18- or 22-bit address decoding. Control and status register permits isolation of memory faults and provides software compatibility with the company's operating systems. Both modules accommodate jumpers for battery backup. **Digital Equipment Corp,** Maynard, MA 01754.

Circle 404 on Inquiry Card



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For information about Spectrum Control and EMC technology, write: Spectrum Control, Inc., 8061 Avonia Rd., Fairview, PA 16415. Call: 814-474-1571.

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CIRCLE 156 ON INQUIRY CARD

MEMORY SYSTEMS

128k memory system

RAMDISK™ functions as an additional disc in conjunction with an Atari 810 disc drive or as bank selectable RAM. System is organized into eight 16k pages that can be selected under program control. Module is installed in second RAM slot in the Atari 800 with 16k RAM modules in the first and third RAM slots providing 160k bytes of memory. System includes 128k module, operating manual, DOS memory management software, and utility software. **Axlon Inc,** 170 N Wolfe Rd, Sunnyvale, CA 94086.

Circle 405 on Inquiry Card

0.25″ streaming cartridge tape drive

Designed for use in Winchester disc backup applications, Quarterback™ is available with 90 or 30″ (230- or 76-cm)/s operating speed. At 90″ (230 cm)/s, unit transfers 20M bytes of formatted data onto single cartridge in just over 4 min. Unit's intelligent controller relieves host computer of overhead functions such as tape formatting, error detection and correction, file mark positioning, and tape positioning. **Cipher Data Products, Inc,** 10225 Willow Creek Rd, San Diego, CA 92138.

Circle 406 on Inquiry Card

High density memory storage board

Using 64k RAM chips, board stores up to 1536k bytes of data and is implemented with a timing and control board that supports 1 or more memory boards. In 3M-byte systems, 3 high density boards will replace 16 std memory boards, memory expansion chassis, and 2 interface boards. Board features single-bit error correction, double-bit error detection, diagnostic capabilities, error logging capability, and transparent refresh. **Harris Corp, Computer Systems Div,** 2101 W Cypress Creek Rd, Fort Lauderdale, FL 33310.

Circle 407 on Inquiry Card

MICROPROCESSSORS/ MICROCOMPUTERS

8085 based microprocessor cards

AM8001 4-MHz CPU card, a standalone system composed of 512 bytes of RAM, 800 bytes of EPROM, and 44 individually programmable I/O lines, features 2 external priority interrupts that enable CPU to interface with external events synchronous to its operation. Additional features include 2 mechanical relays for simple contact closure to an external event, onboard 4-section DIP switch for selecting onboard options, software programmable onboard hardware timer, and offboard hardware timer. **Ampower Electronic Instrument Co, Inc,** 26 Just Rd, Fairfield, NJ 07006.

Circle 408 on Inquiry Card

8-bit microcomputer

MC146805G2 CMOS MCU combines the MC146805E2 with 2.2k-bytes of ROM. Self-testing microcomputer contains 112 bytes of RAM and will branch on condition on any RAM bit or any of 32 I/O pins. Four of the pins drive 10 mA for LED displays, 12 drive 2 mA, and 16 drive 2 low power Schottky TTL loads. The 40-pin device runs at dc to 1.0 MHz using 3- to 6-V supply; with 5-V supply, typical power consumption is 15 mW. In low power modes, it has a range of 0.1 to 3.0 mV. **Motorola Inc, MOS Integrated Circuits Div,** 3501 Ed Bluestein Blvd, Austin, TX 78721.

Circle 409 on Inquiry Card

6502 based single-board computer

Model 6500 provides 72 I/O lines, 1k to 4k bytes of RAM, 2k to 20k bytes of ROM, 5 timers, and 2 levels of interrupt on a 4.5 x 6.5″ (11.4- x 16.5-cm) board. Accessories include 20-char remote mounted display, 20-char thermal printer/plotter, memory expansion boards, 2 panel mounted flat keyboards, and EPROM programmers. Computer is software compatible with Rockwell AIM-65 and Microflex computers, and runs on a singel 5-V power supply. Basic system, containing 6502 microprocessor, 1k byte of RAM, and 72 I/O lines, is OEM priced at $195. **CUBIT, Inc,** 240 Polaris Ave, Mountain View, CA 94043.

Circle 410 on Inquiry Card

Microcomputer system handles up to 8 users with satellite processor cards

A modular, multi-user, 8-bit microcomputer system, Mariner™ allocates a separate satellite processor card, with a Z80A processor and 64k bytes of RAM, to each of up to 8 online users. Independent satellites are linked via S-100 bus to mass storage devices and other peripherals. A master processor oversees system operation and arbitrates bus usage. Communications architecture enables peripherals and common data base to be shared by all users, while giving each operator access to a complete computer.

Housed in a single cabinet, system can be configured with 1 or 2 single- or double-sided floppy drives, for capacity of up to 2M bytes, and an 8″ (20-cm) Fujitsu Winchester hard disc drive with 21M-byte capacity. Hard disc backup is provided by a 0.25″ (0.64-cm) streaming tape drive. In addition to storage peripherals, system supports virtually all RS-232 display terminals. A variety of printers can be installed, including those with serial and Centronics-type interfaces.

System is easily upgraded in the field; additional component interface boards and satellite processor cards are simply inserted into the unit's card cage. To simplify servicing and upgrading, card cage is attached to the hinged front panel, allowing unrestricted access to the boards. Peripheral storage and tape drives are also designed for modular insertion and removal. System measures 29 x 14 x 20″ (74 x 36 x 51 cm) and accommodates either 110-V, 60-Hz or 220-V, 50-Hz power sources. **Micromation, Inc,** 1620 Montgomery St, San Francisco, CA 94111.

Circle 411 on Inquiry Card

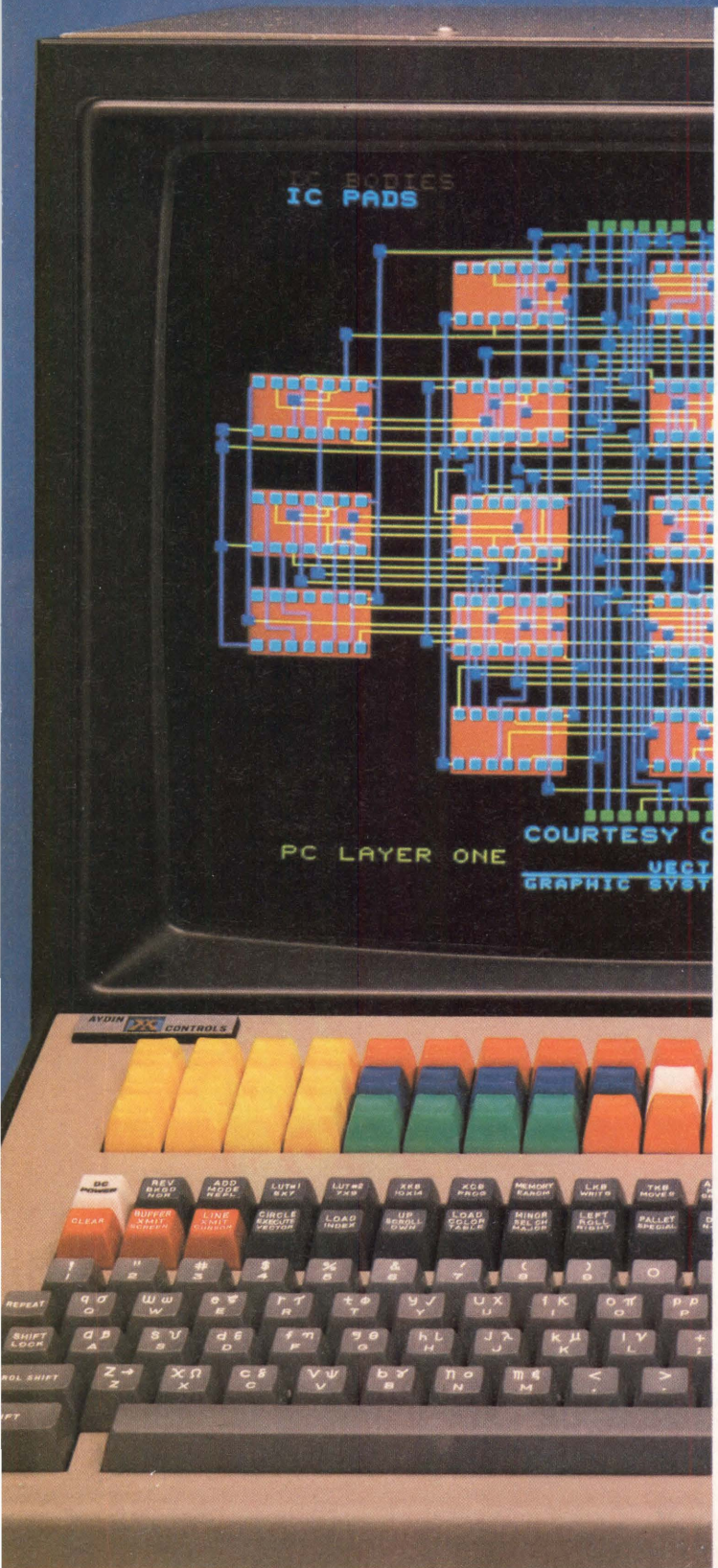
Single-board computer

RM65-1000, the first single-board computer in the RM 65 family, includes an R6502 CPU, 2k bytes of RAM, 16k bytes of P/ROM/ROM capacity, and an R6522 VIA that provides two 8-bit parallel ports with handshake, two multimode 16-bit timers, and an 8-bit serial shift register. Switches dedicate functions on the module to either of two 65k-byte memory banks, or to both. Price is $185. **Rockwell International, Electronic Devices Div,** 3310 Miraloma Ave, Anaheim, CA 92803.

Circle 412 on Inquiry Card

Quickens Your Draw

Aydin user-oriented, full-color graphic systems let you tackle complex design and processing projects quickly and easily.



Aydin 5216 high-resolution multiprocessor-based color graphic systems lead the industry in fulfilling the needs of intricate process control CAD/CAM, simulation, C³I, image processing and many other sophisticated applications.

Versatility is the result of the Aydin growing family of hardware and 2D, 3D, imaging and CORE software modules. The 5216 gives you both the flexibility and programmability to design and implement your ideas efficiently and economically; a true man-machine interface. For example, AYGRAF instruction sets provide both standalone and distributed processing capabilities to support 2D graphics in a standardized manner. The 3D system, which supports standalone and host-driven applications, is designed to give the user the full benefit of sophisticated graphics, all with interactive control that doesn't burden the host computer.

Aydin modular design also means that you can customize the 5216 to your strictest requirements, easily expand memories, add storage and utilize various user-programmable lookup tables. In addition, a host of interactive devices are available, including joysticks, trackballs, graphic tablets, touch panels and lighted or non-lighted function keys.

It all adds up to a user-oriented 5216 color system that is a reliable, flexible and economical solution to your graphics and image processing needs. Quicken your draw with Aydin, the industry leader in high-resolution, intelligent color graphics. For more information, contact Aydin Controls, 414 Commerce Drive, Fort Washington, PA 19034. Tel.: 215-542-7800. (TWX: 510-661-0518.)

Leadership Features:

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- Pixel or graphic DMA block mode data transfer (800 nanoseconds per 16-bit pixel)
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- High-speed hardware vector and character generation
- Four sizes of alpha characters
- High-speed hardware math
- Both parallel and serial peripheral interfaces available
- User programmable
- 16-Bit microprocessor.

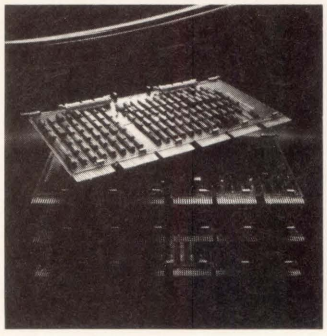
AYDIN CONTROLS

CIRCLE 157 ON INQUIRY CARD

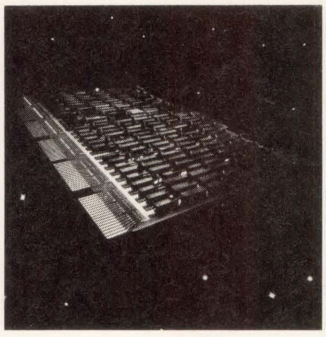
DESIGN

PERFORMANCE

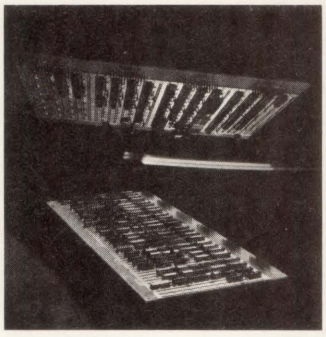
RELIABILITY



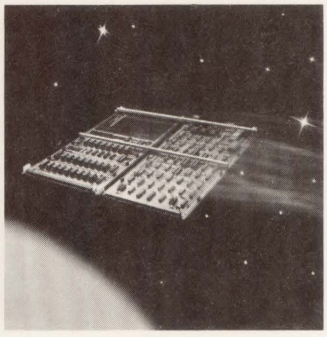
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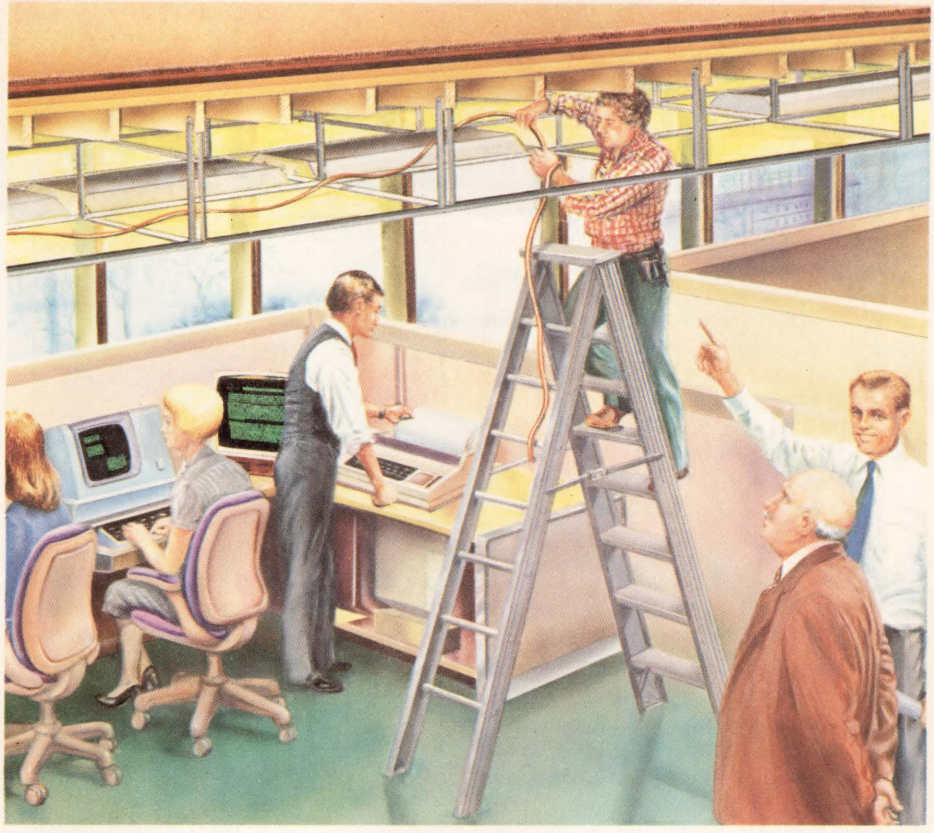
INFORMATION PRODUCTS SYSTEMS

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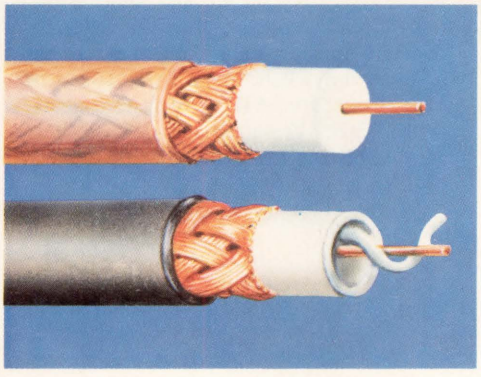


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Times' PL Series cables are listed with Underwriters Laboratories and pass the Steiner Tunnel Test. They meet fire code requirements and can be installed without expensive metal conduits. Best of all, they're much easier and faster to use: lighter, smaller, more flexible.

Times' PL Series cables are available in a wide range of constructions for every electronic communications need: RG62/U type (95 ohms) is ideal for CRT interconnect; RG6/U, RG11/U and RG59/U types (75 ohms) are for hook-up of video systems; RG8/U type (50 ohms) is designed for Ethernet* applications. Times also has the ability to custom design and manufacture plenum cables to meet special requirements.

So look to Times for the best plenum cables. For more information, contact the Industrial Products Group, Times Fiber Communications, Inc., 358 Hall Avenue, P.O. Box 384, Wallingford, CT 06492, Telephone (203) 265-8500.



Times' plenum cable (shown above) features a specially formulated high-velocity fluorocarbon dielectric as compared with ordinary air dielectric cable (shown below).

TFC

TIMES FIBER COMMUNICATIONS, INC.
Times Wire & Cable Div.
An Insilco Company

*Reg. trademark of Xerox Corp.

CIRCLE 158 ON INQUIRY CARD

MICROPROCESSORS/ MICROCOMPUTERS

MC68000 based single-board computer

OB68K1 Multibus/IEEE P796 bus compatible 16-bit computer is capable of functioning standalone, or as the central processor card in a large microcomputer system. Board is available with either 32k or 128k bytes of RAM, 8 sockets for up to 64k bytes of EPROM, 7 prioritized vectored interrupts, and a 16-MHz crystal controlled clock. Other features include 2 RS-232-C serial ports and 2 programmable 16-bit parallel ports. **Omnibyte Corp,** 245 W Roosevelt Rd, West Chicago, IL 60185.

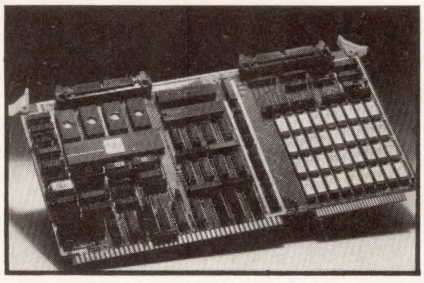
Circle 413 on Inquiry Card

Z80 based single-board computer

STD BUS compatible RMC-80 includes 2-MHz Z80 CPU; byte-wide format memory that allows a combination of RAM, EPROM, and ROM totaling up to 64k bytes; a combination of 2716, 2732, and 2764 EPROMs also totaling up to 64k bytes; 4 RS-232-C ports; and 48 TTL lines. Analog input section provides capability to multiplex up to 32 single- or 16 double-ended signals and to digitize at rates up to 15 Hz. **Environmental Systems Corp,** 200 Tech Center Dr, Knoxville, TN 37912.

Circle 414 on Inquiry Card

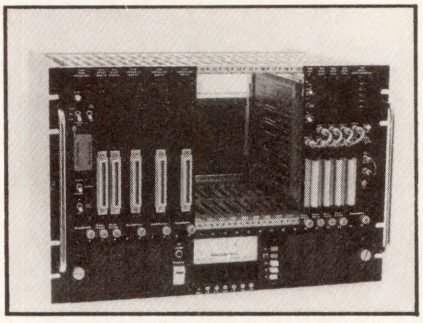
Multibus compatible single-board computer



Designed around Motorola's 16-bit MC68000, which uses 32-bit wide internal data paths, the 16-bit FT-68M provides 68000 chip, 256k bytes of RAM, memory management and protection, serial and parallel communication facilities, and 5 counter/timers on a single board. Compatible with Microsoft's XENIX, the computer features 16 32-bit registers, 3 major data sizes, flexible addressing modes, no wait states with local RAM, up to 32k bytes of P/ROM, and a single 16-bit input port. **Forward Technology Inc,** 2595 Martin Ave, Santa Clara, CA 95050.

Circle 415 on Inquiry Card

LSI-11 based microcomputer system conforms to CAMAC standard



A compact LSI-11 microcomputer system in a standard CAMAC crate, the 8033 CONCEPT can be used as a standalone system or as an integral part of a CAMAC serial highway. The system conforms to the internationally accepted CAMAC (ANSI/IEEE-583) standard for computer automated measurement and control and is suited for a variety of applications, including laboratory automation, industrial process control, distributed control systems, and software development.

Using DEC's LSI-11/23 processor as its CPU, the expandable system takes advantage of CAMAC's modularity and incorporates standard LSI-11 modules. Major components include a 3823 processor adapter unit (housing an LSI-11/23 CPU module), a 3824 peripheral adapter unit (housing standard LSI-11 memory or peripheral interface modules), a 3923 CAMAC crate controller for the LSI-11 bus (serving in either main or auxiliary mode), and a 1500 25-slot CAMAC crate (housing the user's microcomputer system and process modules). System features include an asynchronous serial port, 4 strap-selectable LSI-11/23 interrupt levels, a realtime clock, and support for multiple crates on a single LSI-11 bus.

The system operates under the RT-11 or RSX-11 operating system and features an I/O mapping concept that allows four registers in the crate controller to be mapped anywhere in the LSI-11's I/O page. Prices for a 64k-word system starts at $13,500. **KineticSystems Corp,** 11 Maryknoll Dr, Lockport, IL 60441.

Circle 416 on Inquiry Card

4-MHz Z80A processor board

MDS-Z80A has onboard byte-wide memory that allows any mapping combination of up to 4k bytes of RAM and 8k bytes of ROM or EPROM. Power-on jump feature allows ROM programs to reside on any 2k (2716 P/ROM) or 4k (2732 P/ROM) address boundary. Board also provides memory and I/O page registers for multiuser applications, control of an LED indicator for applications with self-test capabilities, dynamic RAM refresh, power-on reset, and fully buffered address, data, and control buses. **Micro Digital Systems,** PO Box 407, Norfolk, MA 02056.

Circle 417 on Inquiry Card

MC68000 based central processor card

CPU/68000 has 32-bit internal architecture, 7 prioritized interrupt levels, onboard ROM-resident monitor, and up to 16M bytes of direct addressing using IEEE-696/S-100 std 24-line address lines. S-100 bus compatible 8-MHz board runs with all 4-MHz S-100 peripherals. Provision for a multi-user system is provided by addition of a memory management board. Development system using this CPU is also available. **Dual Systems Control Corp,** 1825 Eastshore Hwy, Berkeley, CA 94710.

Circle 418 on Inquiry Card

Dual processor microcomputer system

Intended for industrial use, Inspector™ 200 has 8-bit 8085 and 16-bit 8088 processors, both operating at 6 MHz, allowing the system to run CP/M® or CP/M 86. Housed in a desk style workstation, basic system includes 64k bytes of RAM; dual double-density floppy disc drives with 1M byte of mass storage; 150-char/s, 80-col printer; CRT terminal; and application software, including a statistical analysis package. **Pragmatic Designs, Inc,** 950 Benicia Ave, Sunnyvale, CA 94086.

Circle 419 on Inquiry Card

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Metal Edge Connector Panels — high-quality, at competitive prices.

SEM/NAFI Panels — a tuning fork panel and plug module system that meets MIL-C-28754 and WS 6157 connector packaging concepts.

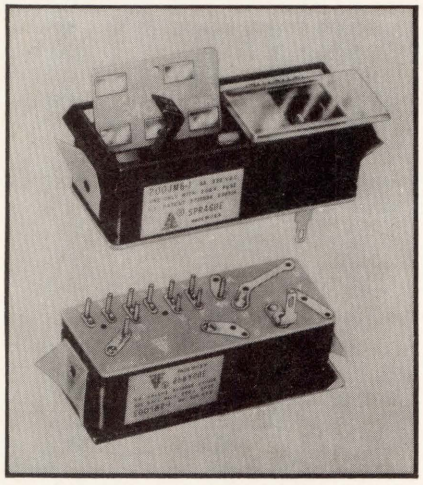
So let TRW Cinch Connectors become your primary source for Back Planes. Call or write your TRW Electronic Components Sales Office . . . listed in EEM or TRW Cinch Connectors, a Division of TRW Inc., 1501 Morse Avenue, Elk Grove Village, Illinois 60007. 312/981-6000.

TRW CINCH CONNECTORS

CIRCLE 159 ON INQUIRY CARD

INTERCONNECTION & PACKAGING

Fused multivoltage connector



Type 200JM6-1 connector accepts a std IEC Type V 3-pin plug and features an integral fuse holder with fuse pull. Operating voltages can be 100, 115 to 120, 220, and 230 to 240 Vac, 48 to 440 Hz, at up to 6 A rms max. Max leakage current is 0.5 μA. Test voltage is 2250 Vdc or 1500 Vac line-to-ground. No hardware is required for installation; mounting taps provide self-locking capability. **Sprague Electric Co,** 555 Marshall St, North Adams, MA 01247.

Circle 420 on Inquiry Card

Open frame std bus card cage

Slant Rack™ holds boards at an oblique angle, leaving outer edges accessible for installation of terminal blocks, std pots, ribbon cable connectors, alphanumeric displays, and wires. The end card is completely visible, permitting use as a control panel. Measuring 10 x 5.5 x 5.5″ (25.4 x 14 x 14 cm), the card cage provides 6 slots with 0.75″ (1.91-cm) center to center card spacing, includes room for an end rack switching power supply, and fits into a 7″ (18-cm) deep NEMA enclosure. **Circuits and Systems, Inc,** 2 Main St, Hollis, NH 03049.

Circle 421 on Inquiry Card

Press-fit backpanel systems

Industry compatible backpanels are completely interchangeable with existing backpanels. They are based on the "Graduate" press-fit connector that features simplified single contact and insulator replaceability, a compliant press-fit section, long life contacts, 0.350 or 0.410″ (0.889- or 1.041-cm) card slot depth, and a full-length card straightener to aid insertion of warped cards. Units have up to 11 layers containing over 18,000 contacts and feature a high degree of design flexibility. **Elco Corp, Interconnect Systems Div,** 2250 Park Pl, El Segundo, CA 90245.

Circle 422 on Inquiry Card

Round conductor flat cable

PANFLEX™ PVC insulated cable features 7-strand design that permits bends and foldouts without damage to insulation or conductors. Ten widths are available for 0.050″ (0.127-cm) centerline cables that have 10, 14, 16, 20, 26, 34, 40, 50, 60, or 64 circuits, and 28 AWG wire with green coding stripes. The 0.100″ (0.254-cm) centerline cable is offered with 2 through 28 conductors in 22, 24, and 26 AWG wire gauges. Flat cable with 0.156″ (0.396-cm) centerline is available with 2 through 24 conductors in 18, 20, and 22 AWG. **Panduit Corp, Electronic Products Group,** 17301 Ridgeland Ave, Tinley Pk, IL 60477.

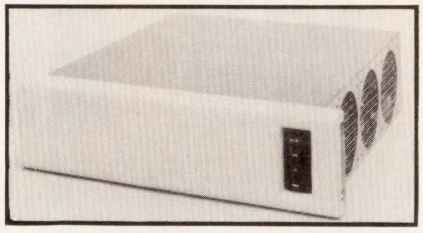
Circle 423 on Inquiry Card

Customizable enclosures

Series CLH enclosures feature a turning handle that doubles as a tilt stand; positive setting of the handle position is accomplished through a lock nut on either side of the case. Enclosures measure 12.5 x 11.63″ (31.8 x 29.54 cm) and are available in heights from 4.51 to 5.76″ (11.46 to 14.63 cm) in 0.25″ (0.64-cm) increments. Molded of heavy weight ABS material, units use integral mounting bosses, PC card guides, mounting rails, accessories, and other hardware to provide design flexibility. **PacTec Corp, Subsidiary of LaFrance Corp,** Enterprise and Executive Aves, Philadelphia, PA 19153.

Circle 424 on Inquiry Card

System boxes



MLSI-BA11-600 series for DEC LSI-11/2 and /23 computers incorporates a ruggedized version of the BPA84 backplane/card cage assembly that has 14 slots dedicated to Q-bus signals. Boxes provide 22-bit addressing and include power failure sequencing circuity and a line time clock. A switching power supply provides 5 Vdc at 25 A, 12 Vdc at 4 A, and −12 Vdc at 1 A. Boxes are RETMA rack mountable and are available in front and rear loading models **MDB Systems, Inc,** 1995 N Batavia St, Orange, CA 92665.

Circle 425 on Inquiry Card

PCB connectors

Series 08 and 09 TEKBOX connectors provide interconnection between PCBs and cable assemblies. PCBs can be interfaced to each other either vertically or horizontally. Features include stamped and formed contacts and associated housings, and mating header assemblies with molded in contacts having 0.025″ (0.64-cm) square posts. Connectors are composed of single- and double-row configurations with various plating options. **Teka Products, Inc,** 60-06 39th Ave, Woodside, NY 11377.

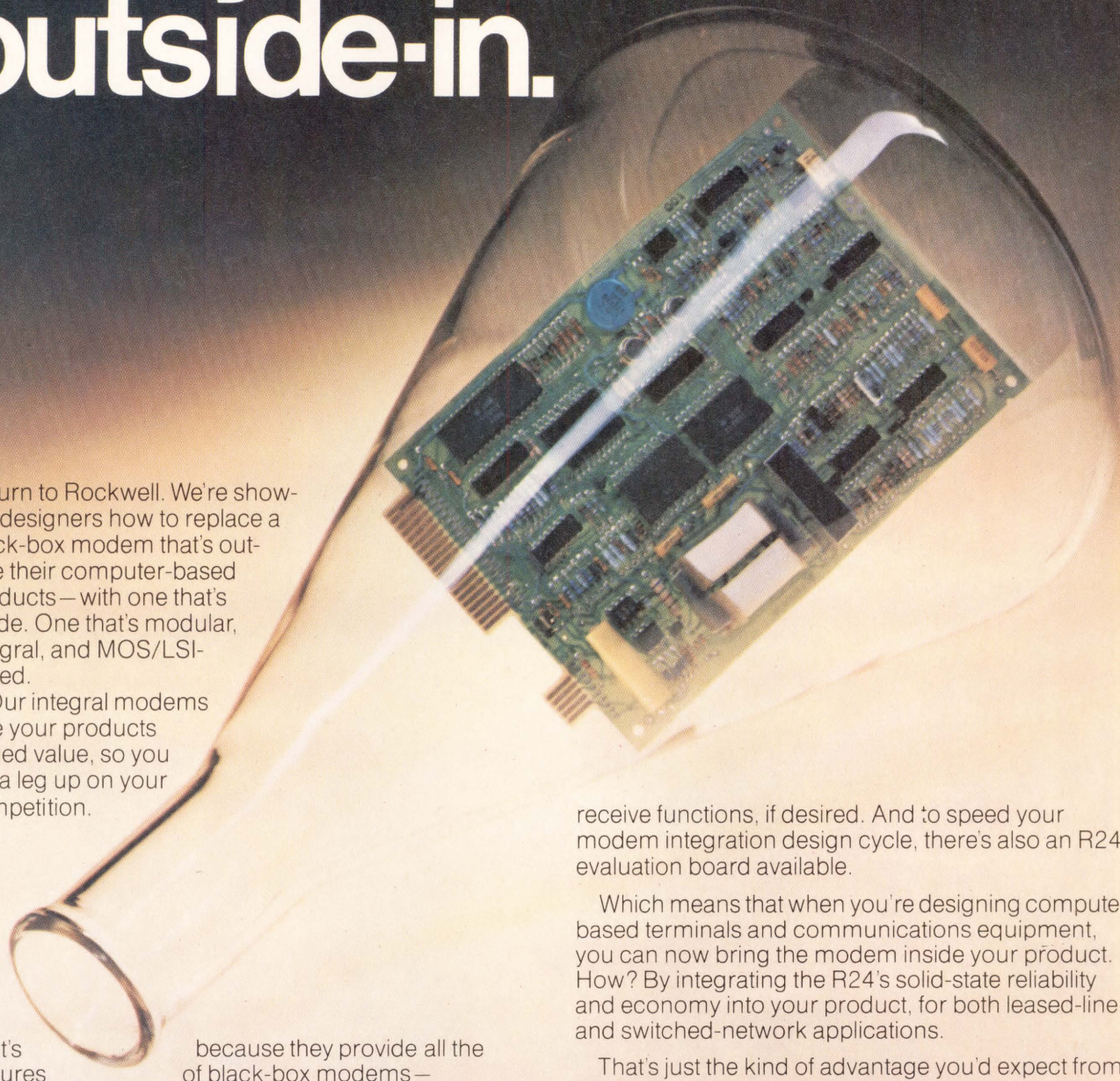
Circle 426 on Inquiry Card

Cardedge connectors

Series 173 connectors provide from 40 to 79 connections on 0.125″ (0.318-cm) centers. Connector housing measures 10.68 x 0.360 x 0.610″ (27.13 x 0.914 x 1.549 cm) and can be flush mounted via threaded inserts or recessed mounted via 0.128″ (0.325-cm) diameter through-holes. Total insertion force is 50 lb (23 kg) max, while separation force for each contact position is 1 oz (28 g) min. Gold-plated contacts are rated at 3 A; other plating finishes are optional. **Methode Electronics, Inc, Connector Div,** 7447 W Wilson Ave, Chicago, IL 60656.

Circle 427 on Inquiry Card

How to turn your modem outside-in.



Turn to Rockwell. We're showing designers how to replace a black-box modem that's outside their computer-based products—with one that's inside. One that's modular, integral, and MOS/LSI-based.

Our integral modems give your products added value, so you get a leg up on your competition.

That's because they provide all the features of black-box modems—but at a fraction of their cost. Plus their compactness gives you new physical design freedom.

And Rockwell modems are available at a level of integration that meets your requirements. Take our R24, for example. A 2400-bps synchronous modem, it comes in three configurations—all exceptionally compact, and compatible with Bell 201 B/C and CCITT V.26 A/B standards.

First there's our fully assembled and tested single-board modem, ready to plug into your system—like the one shown above. Then there's our set of three discrete modules, ready to be designed into your own modem. They allow you to separate transmit and receive functions, if desired. And to speed your modem integration design cycle, there's also an R24 evaluation board available.

Which means that when you're designing computer-based terminals and communications equipment, you can now bring the modem inside your product. How? By integrating the R24's solid-state reliability and economy into your product, for both leased-line and switched-network applications.

That's just the kind of advantage you'd expect from Rockwell, the company that's delivered more integral LSI 4800/9600-bps modems than anyone else in the world. That's right—*anyone*. And Rockwell modems are in stock now—fully assembled, on production or evaluation boards, or as discrete modules.

So don't leave your modems on the outside looking in. For information or applications help, call toll free: (800) 854-8099; in California, (800) 422-4230. Or write: Rockwell International, Electronic Devices Division, RC55, P.O. Box 3669, Anaheim, CA 92803.

Rockwell International

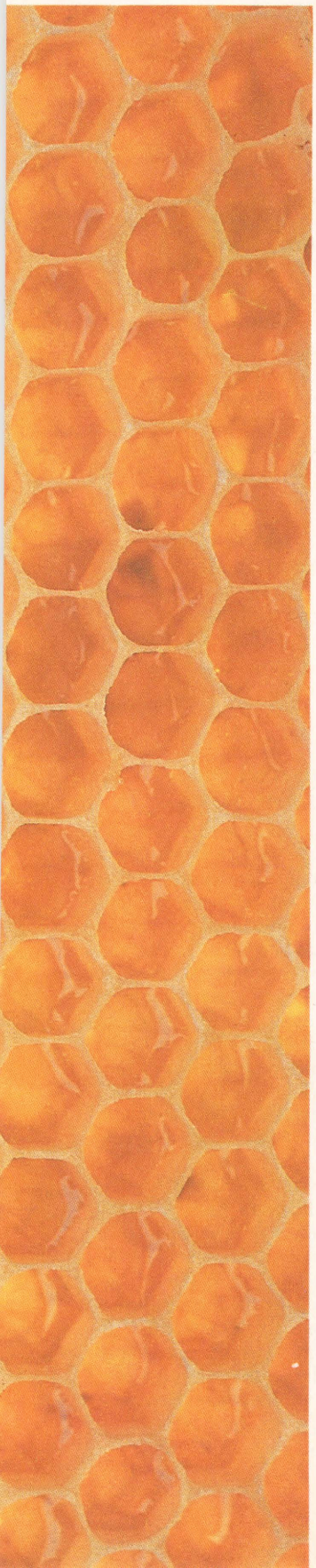
...where science gets down to business

CIRCLE 160 ON INQUIRY CARD

AMI Standard Cells. Custom



designs from basic elements.



Everyone agrees that custom integrated circuits provide optimum solutions where standard products do not. They reduce component count to save space, power, and test time. And since component count is reduced, production costs are lower. System reliability is higher. And you get proprietary protection of your circuit.

Now AMI offers all the benefits of custom circuits in half the development time and cost. With AMI Standard Cells. Custom designs from standard circuit elements.

How AMI standard cell designs are developed. Computer-drawn custom integrated circuits can be developed quickly from a library of standard logic cells. These logic cells include gates, flip-flops, counter and register bits, and I/O elements that have been previously laid out and tested. The computer combines and arranges the cells to produce a custom design that meets your exact performance needs. In less time, at less development cost. And every circuit is tested to a 0.1% AQL.

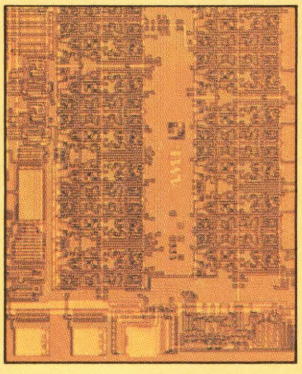
Why you need them. Our standard cell designs make custom circuits cost-effective for volumes as low as 10,000 circuits. Standard cell designs are especially valuable when an accelerated development cycle is required. Or when production volume is too low to absorb the cost of conventional custom design.

In addition to standard cell designs, AMI offers a full spectrum of other custom approaches to best meet the needs of your market place. Approaches like semicustom logic arrays. Computer-aided and hand-drawn custom circuits. We can even teach you to design your own circuits. And we will provide custom fabrication for your designs.

How they save. AMI can develop standard cell circuits 6 to 12 weeks faster than conventional custom. For circuits of moderate complexity (1000 gates), it takes as little as 14 weeks to the first devices.

What's more, development cost can be 30% to 50% lower.

We're designing standard cell circuits in both NMOS and CMOS. And while they won't replace all our custom designs, they can give you a custom circuit for less development money, in less time than ever before.



Amazing, isn't it, what you can do with a few basic elements?

To find out more about AMI standard cells, just call Custom Marketing at (408) 246-0330, ext. 203, or send in the coupon below.

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The most natural solutions in MOS.

Finally! The benefits of custom design without the development time and cost. I want to know more.

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___Send me your capabilities brochure, "The AMI Spectrum of Custom Solutions."

___Have a field engineer call me.

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Company _____ Phone ( ) _____

Address _____ M/S _____

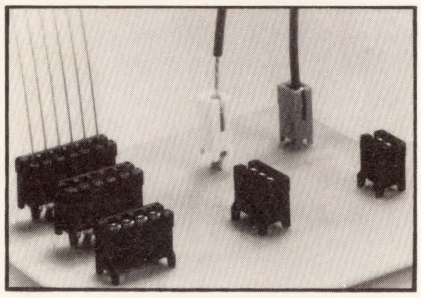
City _____ State _____ Zip _____

Send to: AMI Standard Cells, 3800 Homestead Road, Santa Clara, CA 95051

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INTERCONNECTION & PACKAGING

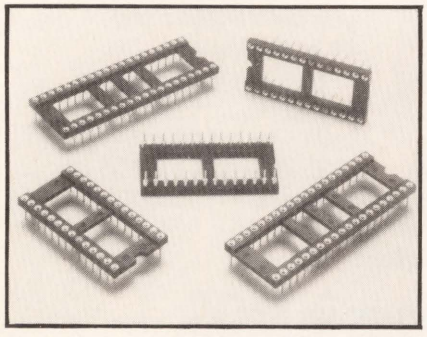
Zero insertion and extraction force connectors



Wirepost connector terminates discrete wire sizes #22, #24, and #26 AWG to PCBs without soldering, crimping, or wire-wrapping. Connector is soldered to PCB; wire is then terminated to PCB by sliding plastic body up, inserting prestripped solid (tin or solder plated) or stranded (tin or solder coated) wire into connector receptacle, and snapping body down to lock and complete connection. Wire is removed by lifting plastic housing, which releases inner contact. **Burndy Corp, Components Div,** Richards Ave, Norwalk, CT 06856.

Circle 428 on Inquiry Card

Low profile machined pin sockets



Open frame sockets are available in both 3-level and solder tail types that accommodate 8- through 40-pin flat lead DIP ICs or 0.016 to 0.021″ (0.41- to 0.53-cm) diameter round leads. Designed to meet MIL-S-83734, sockets have a 2-piece tapered entry socket terminal, 4-leaf machined closed contact, and machined outer sleeve. Two-piece machined socket terminal has inner contact of beryllium copper, gold-over-nickel or tin plate. Outer sleeve is brass, gold-over-nickel or tin plate. **Scanbe, Div of Zero Corp,** 3445 Fletcher Ave, El Monte, CA 91731.

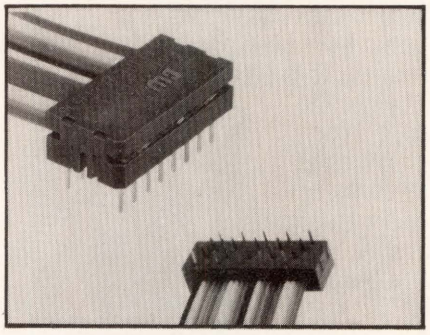
Circle 429 on Inquiry Card

Laminated flat ribbon cable

Series 9L282 cables feature 28-gauge stranded tinned copper conductors spaced at 50-mil (1.27-mm) centers for quick termination with std insulation displacement connectors. An overall Beldfoil® aluminum-polyester shield with 2 drain wires surrounds the cable, reducing the effects of rfi and emi on system operation. Cables are available in 11 sizes with 9 to 64 conductors on 100′ (30-m) rolls. Nominal impedance is 52 Ω (shield grounded) and 70 Ω (shield floating). **Belden Corp, Electronic Div,** Richmond, IN 47374

Circle 430 on Inquiry Card

Insulation displacement connectors



CWR-130 series DIP connectors are available in 14-, 16-, 24-, or 40-pin configurations with bare 725 alloy contacts, or tin- or gold-plated contacts that meet MIL-C-83503/6 requirements. Strain relief is available as required, providing more than 0.5-lb (0.2-kg)/contact protection from forces applied to the cable. CRW-142 series PCB connectors are available in sizes from 10 to 50 contacts. Optional strain relief and closed end construction styles are available with gold-plated phosphor bronze or bare 725 alloy contacts; a tin-plated MIL-C-83503/23 version is available as well. **CW Industries,** 130 James Way, Southampton, PA 18966.

Circle 431 on Inquiry Card

DATA CONVERSION

Protocol converter



DataLynx/3270 enables ASCII asynchronous terminals to emulate IBM's 3277-2 display station for interactive communications with a binary synchronous host. Device appears to the host as an IBM 3271-2 cluster controller, converting EBCDIC code and bisync data format into ASCII code and asynchronous format. Features include 2 asynchronous RS-232-C I/O channels, an I/O channel dedicated to binary synchronous communication, 10k-byte RAM buffer storage, and 12k-byte EPROM program storage. Converter is priced at $1950. **Local Data,** 2701 Toledo St, Torrance, CA 90503.

Circle 432 on Inquiry Card

8-bit DAC is compatible with 4- and 8-bit microprocessors

Configured to interface with 4- or 8-bit microprocessors, DAC-808 includes a master/slave latch combination that allows data to be entered while the output is held at its previous level until a transfer command is given. This feature is useful in bus-oriented systems in which data for a number of DACs must be loaded sequentially, but in which all outputs must change simultaneously. There are 6 modes of operation. Mode 1 is used for an 8-bit transfer. Modes 2 through 5 are intended for 4-bit operation, and mode 6 is a no-operation (storage) mode.

True output compliance for the DAC is −5 to 8 V; nonlinearity is 0.1% of full scale (max); settling time is 500 ns (max); and power dissipation is 120 mW. The DAC is available in 7 grades, including 2 grades processed according to MIL-STD-883 class B. Commercial, industrial and military temperature range grades are available. All devices are supplied in 18-pin ceramic DIP packages. **Precision Monolithics Inc,** 1500 Space Park Dr, Santa Clara, CA 95050.

Circle 433 on Inquiry Card

Announcing new standards for image processing.



COMTAL's new low cost, standard systems

COMTAL leads the way again. Now, COMTAL offers standard versions of its Vision One/10 and Vision One/20. For as little as $33,250, you can have a full-scale, real-time digital image processing system — with delivery in less than sixty days!

Price and delivery breakthroughs

COMTAL's new standard systems, the Vision One/10-M6 and the Vision One/20-M8, represent major breakthroughs in price and delivery for digital image processors. Because of COMTAL's continuing technical leadership in the industry, vigorous expansion in the market, and the economies of scale through expanded manufacturing facilities, only COMTAL can make this kind of offer.

Large-scale features

COMTAL's new standard systems perform maturely. Each can operate as a real-time, stand-alone or host-interfaceable system. Each provides real-time roam and zoom, pseudocolor processing, and contrast stretching. Even the operating systems are standard! The Vision One/10-M6 is a compact, table-top system. The Vision One/20-M8 is a more powerful system with a larger memory capacity, a second user channel capability, and a broader range of options.

From the leader

With these new, economical standard systems, COMTAL advances its tradition of innovative leadership in image processing. Only COMTAL can offer this combination of performance, price and predictable delivery. Check it out.

With the cost of digital image processing lower than ever before, isn't it time to explore how digital image processing can help you? Call or write today and learn how you can have a new standard for your image processing and analysis needs.

COMTAL

A subsidiary of 3M
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CIRCLE 162 ON INQUIRY CARD

DATA CONVERSION

Isolated analog input system provides four channels

A 4-channel isolated analog input system, LDT2765 features 4 differential input channels that withstand ±250-V common mode voltages and support a 60-Hz common mode rejection ratio of 126 dB. Designed for the company's LAB-DATAX family of LSI-11 based laboratory data acquisition systems, the device has a standard LAB-DATAX front panel equipped with screw terminals on a barrier strip for secure connection of thermocouples and other lug-terminated transducers. This combination of packaging and electronic features suits the system for acquiring 10-mV full-scale signals generated by thermocouples, strain gauges, and other low level transducers operating in electrically noisy and/or hostile environments.

Offered as a companion, the LDT2775 input expander has 8 isolated differential input channels with the same ±250-V common mode voltage rating and low level measurement capability. Up to 7 expanders can augment each analog input system, for a total of 60 isolated DI channels. Under the DEC RT-11 operating system, the company's DTLIB FORTRAN-callable library can support up to four fully expanded analog input systems.

Each product occupies one dual slot in the Q-Bus backplane within the LAB-DATAX and connects via ribbon cable to the removable screw-terminal front panel plate. The analog input system with front panel is priced at $965 in quantities of 1 to 9; the 8-channel isolated expander with front panel is $720. **Data Translation,** 100 Locke Dr, Marlboro, MA 01752.

Circle 434 on Inquiry Card

CMOS analog I/O microboards

Low power Microboard line includes a combination board containing an ADC with 16 single-ended or 8 differential inputs and 2 DACs, an ADC board, and a dual-channel DAC board. All are available in both unipolar (0- to 2.5-V) or bipolar (±2.5-V) versions, operate from a single 5-V supply, and require no external reference voltages. Op temp range is −40 to 85 °C. Price in 100-unit quantities ranges from $99 to $199. **RCA/Solid State Div,** Rte 202, Somerville, NJ 08876.

Circle 435 on Inquiry Card

Multifunction I/O board

Compatible with Motorola Micromodule™ and designed for use with M6809 based systems using the EXORbus™, Z601 incorporates realtime clock, programmable parallel I/O capabilities, and a GPIB bus interface. Board extends capability of Motorola's EXORset 30A™ for use as a fast, versatile data acquisition system, or as production test system. All hardware and software necessary for IEEE 488 GPIB interface are included. Onboard software is compatible with Motorola BASICM™. **Zeltex Inc,** 940 Detroit Ave, Concord, CA 94518.

Circle 436 on Inquiry Card

75M-samples/s operation claimed for 8-bit ADC board

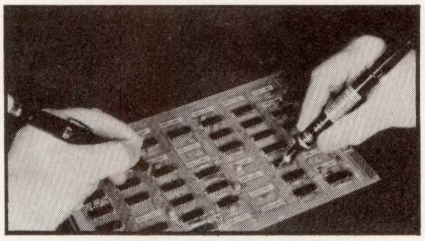
TDC1025E1C ADC board accepts analog signals with a 20-MHz bandwidth and supplies a corresponding 8-bit digital output. The board's 75M-sample/s performance is due to a 1-μ 3-D "flash" monolithic converter. Both the CONVERT signal and the 8-bit binary outputs are buffered, single-ended ECL.

Full scale analog input ranges of 1 to 10 V are selectable by means of onboard resistors. The resistors also select input impedances of 50 to 1 kΩ. Offset adjustments are provided for unipolar or bipolar inputs. Supply voltages for the board are ±15 and −5.2 V. The ±15-V supplies are used to obtain a regulated −2 V reference, −6 V for the "flash" converter chip and 5 V for the internal buffers. Total power dissipation is about 2 W. **TRW/LSI Products,** PO Box 2472, La Jolla, CA 92038.

Circle 437 on Inquiry Card

TEST & MEASUREMENT

Logic pulser



Circuit powered PLS-1 injects either single pulse or dynamic 20-pulse/s train into the circuit node under test. High current pulsing will "punch through" circuit signals for reliable testing. Device features automatic current limiting to 0.7 A nom, input overvoltage protection to ±50 V, high off-state impedance of 1 MΩ, low on-state impedance of 2 Ω, and power lead reversal protection. Pulse polarity sensing and output are automatic. Operation is via fingertip pushbutton. **OK Machine and Tool Corp,** 3455 Conner St, Bronx, NY 10475.

Circle 438 on Inquiry Card

Programmable test set

Model 102050 "Control-A-Load," in conjunction with model 102010 "Dub-L-Load," provides semiautomatic voltage and current testing of a power supply EI output curve. Preprogramming of 8 different outputs is stored in the unit. Each output is tested at 4 points on the output profile. The voltage is compared with the programmed reference and displayed by 4 LEDs to within 0.1% tolerance. Reprogramming requires the replacement of a 16-pin DIP. Accuracy for load current is 2%. Voltage tolerance indicators are 0.1, 0.3, 1, and 3% of the programmed voltage **Caen Engineering,** 19312 Canyon Dr, Villa Park, CA 92667.

Circle 439 on Inquiry Card

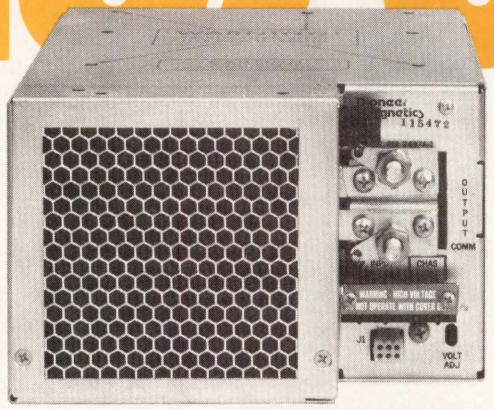
IC memory tester

ROM Test II™ checks and verifies ROMs without incircuit probing of data lines. Instrument is capable of testing any ROM up to 128k bytes in 2 s or less. Four-digit display reads a single signature for memory verification. Error detection probability is 100% for single-bit errors and 99.99% for multiple-bit errors. Unit can be operated from either 115 or 220 Vac (switch selectable). **Kurz-Kasch, Inc,** Dayton, OH 45403.

Circle 440 on Inquiry Card

Dependable Switchers...

1973 1981



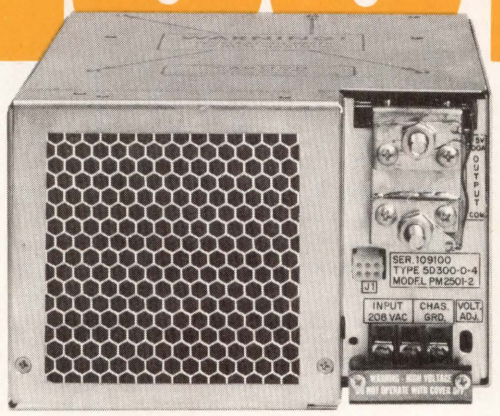
The PM2497
5V@100A/5″x8″x11″

In 1973 Pioneer Magnetics started building a 5VDC @ 100A switching power supply for applications requiring compact and efficient DC power. At the time, commercial switchers were considered state-of-the-art. We solved reliability and delivery problems for our customers that our contemporaries couldn't. As a result, our customers referred to the power supplies as the DEPENDABLES. In fact we're still delivering that same power supply to those same valued customers. We're proud to say that they've depended on us and we've responded by shipping over 100,000 high power switchers. After 8 years our supplies are still out there and running. A continuation of a tradition started in 1958.

STANDARD DC OUTPUT RATINGS.

MODEL	2V	3V	5V	12V	15V	18V	24V	28V	48V	60V	CASE SIZE
PM2496A	100A	60A	50A	30A	25A	22A	16A	13A	8A	6A	5″X8″X11″
PM2497A	200A	100A	100A 120A 150A	60A	50A	45A	33A	27A	16A	12A	5″X8″X11″
PM2500A		200A	200A	85A	70A	60A	45A	40A	24A	19A	5″X8″X11″
PM2498B	400A	300A	200A 300A	120A	100A	90A	66A	54A	32A	25A	5″X16″X11″
PM2501	400A	300A	300A	120A	100A	90A	66A	54A	32A	25A	5″X8″X11″
PM2502	500A	450A	450A	180A	150A	125A	90A	80A	47A	35A	5″X16″X11″

NOTES: 92-138VAC or 184-250VAC single phase, 47 to 63Hz.
DC input available.



The New PM2501
5V@300A/5″x8″x11″

Since 1973, we've been accepting new challenges. Within the same outline as the PM2497, we've developed output ratings of 5V @ 120A, 150A, 200A and now a new 5V @ 300, with full delivered power at 50°C.

The new PM2501 exhibits excellent dynamic response. Proven design concepts enable close control over those parameters that insure reliability. For instance, our unique heat transfer technology results in low component thermal stress, even lower than the PM2497. At three times the power level the PM2501 features an exceptionally high power density package.

Our product line includes switchers that deliver up to 2250 watts in single output and from 375 to 1500 watts in dual through quad output channels. AC or DC input.

Over 100,000 PMI switchers are in the field providing dependable, service free operation. After all, that's why customers have continuously come back to us since 1958.

Pioneer Magnetics

THE SWITCHING POWER SUPPLY PEOPLE SINCE 1958

1745 Berkeley Avenue, Santa Monica, CA 90404 (213) 829-6751

CIRCLE 163 ON INQUIRY CARD

TEST & MEASUREMENT

Optical measurement system

Minicomputer based automated component optical measurement system (ACOMS) model 1100 provides 3-D measurements and a digital database description of cast, forged, and machined components. Inspection analysis of measurement data and accept/reject decisions are based on a comparison with stored specified dimensions and tolerances and are made by the system, without operator assistance. System measures selected features on an engine block to an accuracy of 0.010″ (0.025 cm) rms within a period of 1 hour; it can be configured to provide measurement accuracies to 0.001″ (0.003 cm) rms at a lower throughput rate. **Robotic Vision Systems, Inc,** 536 Broadhollow Rd, Melville, NY 11747.

Circle 277 on Inquiry Card

Multipoint scanning/measuring unit

PM 4011 scanner extension system automatically supervises and acquires data relating to industrial parameters; several hundred different measuring points can be directly connected to the unit for automatic data reduction and presentation. Unit has inputs for a variety of high and low level measurement signal sources. It can also initiate audio/visual alarms and fundamental control signals. **NV Philips' Gloeilampenfabrieken, Science & Industry,** TQ III-4, Eindhoven, The Netherlands.

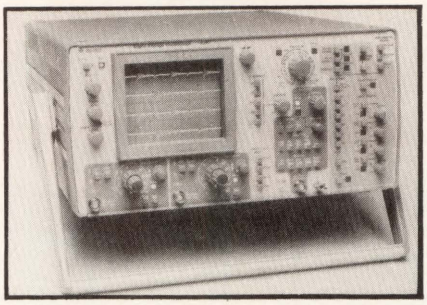
Circle 278 on Inquiry Card

Logic analyzer

Model LAM 4850A, using keyboard entry and CRT display, prompts and guides users through vital steps via a menu driven program. Monitor function lists status information and comments in English. Up to 6 test setups can be stored for months in nonvolatile CMOS memory. Personality modules simplify connection to popular microcomputers, including 8080, 8085, 6800, 6802, 6809, Z80, 1802, and 16-bit 8086. Modular design allows user to add to or change the instrument as necessary. **Dolch Logic Instruments,** 230 Devcon Dr, San Jose, CA 95112.

Circle 279 on Inquiry Card

Digital storage oscilloscope combines digital and analog capabilities



DSO4040 provides digital/analog sampling rate of 10 MHz, digital storage features for high speed transient capture, conventional operation (normal mode) for 25-MHz realtime T-Y and X-Y phase measurements, detailed multitrace comparison, and digital or analog output to data systems or recorders. To provide pretrigger and roll displays, memory size is 8k bytes, any 5k bytes of which can be displayed at one time. Large memory and fast sampling rate permit storage of fast waveforms with high accuracy and capture of slow reactions or multiple events over long time periods.

Device has dual-channel 4-trace display capabilities. In single-channel multisweep mode, 4 sequentially triggered events can be displayed and compared, or up to 3 stored events can be compared with a fourth in real time. In dual-channel mode, 2 stored waveforms can be compared with 2 realtime traces. Stored traces can be shifted on both X and Y axes. To prevent missing very fast transients when instrument is operated at low sweep speeds, scope can be operated in peak detection mode; device then displays envelope of signal's maximum excursions during measurement period.

Waveform details can be expanded up to 50 times in X direction in storage mode and 25 times in normal mode. Trigger controls provide stable triggering of complex input waveforms. Scope is available with analog output unit for use with X-Y or Y-T chart recorders and parallel digital I/O for direct interfacing with I/O port of microprocessors or data handling systems. IEEE-488 bus interface unit is also available. **Gould Inc, Instruments Div,** 3631 Perkins Ave, Cleveland, OH 44114.

Circle 280 on Inquiry Card

SYSTEM ELEMENTS

2.25″ permanent magnet dc servo motors

MS-2220 and -2225 are rated at 96 and 106 W, respectively, and have interference mounting for 2 ball bearing races. Machining of stainless steel shaft to within 0.0002″ (5 μm) gives a close fit for the internal race and ensures no unwanted lateral movement. Units feature skewed armatures, large diamond finished commutators and replaceable brushes, and permanent ceramic magnets to provide low torque ripple, low mechanical noise, and low current density. **Dynetic Systems Inc,** 19128 Industrial Blvd, Elk River, MN 55330.

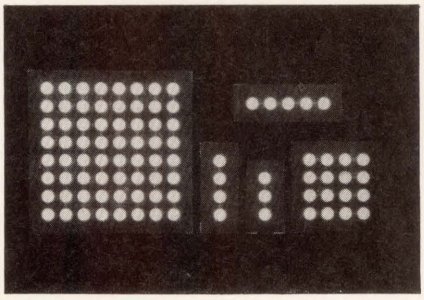
Circle 281 on Inquiry Card

Magnetic card reader/encoder

A 4-track head in the improved KB-32 Microloader™ 2-track allows each track to be read simultaneously. Device has 544-byte/stripe storage capacity, and records and reads over 2100 bytes from the company's magnetic stripe Kilobyte Card. Character load time is 12k bytes/min. Connected to a microcomputer through an RS-232 or TTY interface, it provides low cost, convenient parameter loading. **Vertel,** 125 Ellsworth St, Clifton, NJ 07012.

Circle 282 on Inquiry Card

Membrane switch components



Type "C" series features cover construction that allows use of an existing PCB to form the base or stable layer of the membrane switch package. Components consist of a flexible membrane, a series of individual conductive pads, and a spacer layer. Membrane acts as shorting element for 2 contact points on the board. A custom faceplate can be added to form a customized switch package. Single-unit prices range from $2.70 to $11.60. **W. H. Brady Co, Xymox Div,** 8225 W Parkland Ct, Milwaukee, WI 53201.

Circle 283 on Inquiry Card



NOW PICK JUST THE 132-COLUMN PERFORMANCE YOU NEED.

Choose from our popularly priced Excel 32 to our big screen Excel 14.

All eight Excel models feature superior ergonomics like tiltable displays, non-glare screens, and detachable keyboards with familiar typewriter response.

Standard performance features include bi-directional smooth or jump scrolling, split screen/regional scroll, double-high/wide and double-high characters, keyboard selected set-up parameters and CRT Saver. Plus you get a 128 character set that includes special graphic symbols displayed across either 80 or 132 columns. Various Excel models also emulate many popular terminals and all are designed for high-speed interactive communications.

The new Excel terminals from Datamedia are proven products in advanced ergonomic packages. And they've got what the 132-column market has needed for a long time — Selection. Find out how the smarter terminal maker will make you a smarter terminal buyer. Call (609) 665-5400. Use the handy coupon or write: Datamedia Corporation, 7401 Central Highway, Pennsauken, NJ 08109.

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Eight Excel terminals to choose from.

☐ **EXCEL 12**
- VT100™, VT52™ Compatible
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- 14" Screen

☐ **EXCEL 22**
- VT100, VT52 Compatible
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☐ **EXCEL 24**
- VT100, VT52 Compatible
- 14" Screen

☐ **EXCEL 32**
- "Software Saver" — emulates Datamedia 1521, ADM™3A, Regent™25, and Hazeltine™1420.
- 12" Screen

☐ **EXCEL 34**
- "Software Saver" — emulates Datamedia 1521, ADM 3A, Regent 25, and Hazeltine 1420.
- 14" Screen

☐ **EXCEL 52**
- VT100 Compatible/APL Second Language
- 12" Screen

☐ **EXCEL 54**
- VT100 Compatible/APL Second Language
- 14" Screen

☐ Please call to arrange a demo.

☐ Please send product information.

Return to: Datamedia Corporation, 7401 Central Highway, Pennsauken, NJ 08109 (609) 665-5400.

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Company _____ Title _____

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Phone _____

From the smarter terminal maker.

*VT100, VT52 are registered trademarks of Digital Equipment Corporation; ADM3A is a registered trademark of Lear Siegler, Inc. Regent 25 is a registered trademark of Applied Digital Data Systems. Hazeltine 1420 is a registered trademark of Hazeltine Corporation.

CIRCLE 164 ON INQUIRY CARD

Easy Industrial Control

Make the Connection with DEC and OPTO 22

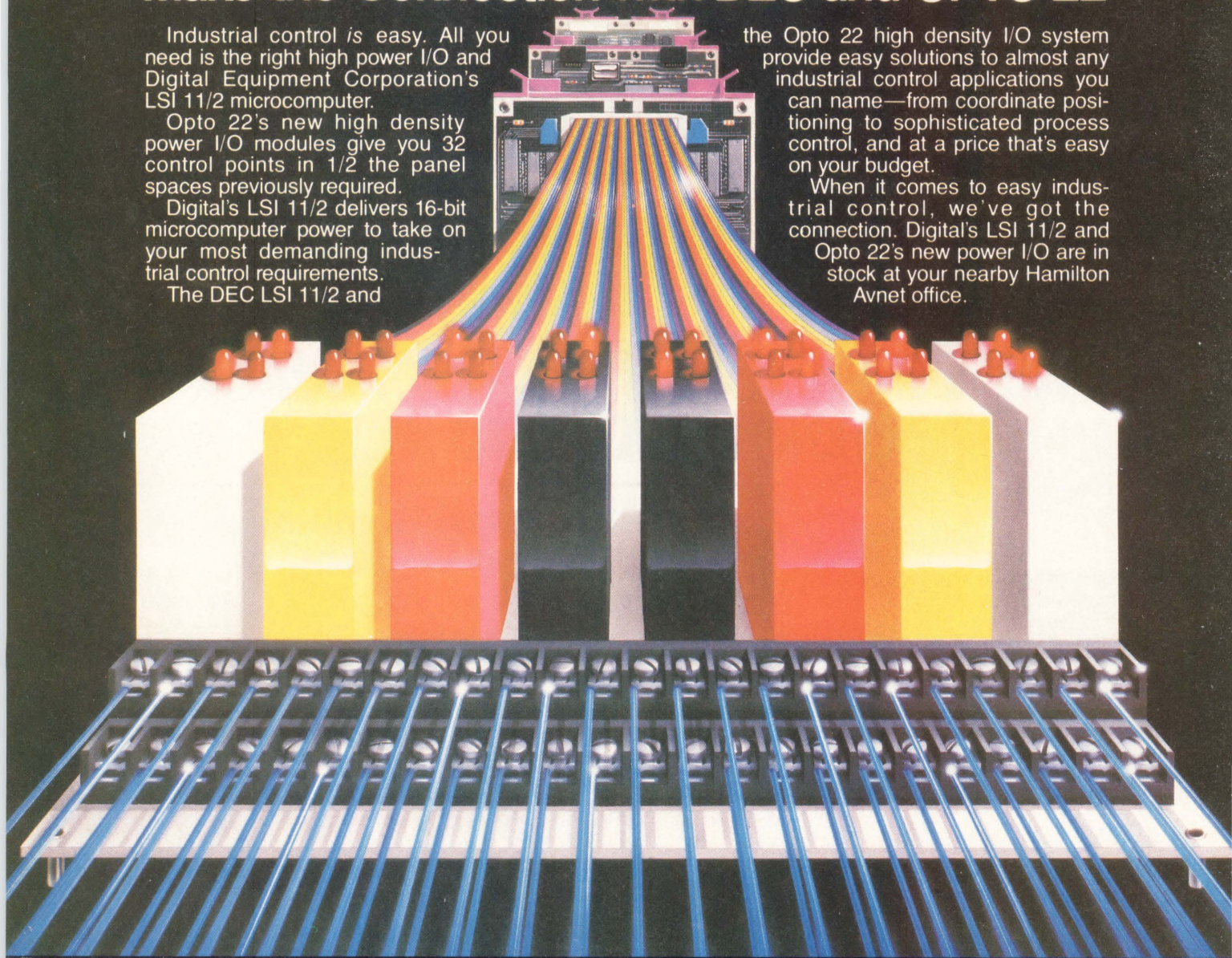
Industrial control *is* easy. All you need is the right high power I/O and Digital Equipment Corporation's LSI 11/2 microcomputer.

Opto 22's new high density power I/O modules give you 32 control points in 1/2 the panel spaces previously required.

Digital's LSI 11/2 delivers 16-bit microcomputer power to take on your most demanding industrial control requirements.

The DEC LSI 11/2 and the Opto 22 high density I/O system provide easy solutions to almost any industrial control applications you can name—from coordinate positioning to sophisticated process control, and at a price that's easy on your budget.

When it comes to easy industrial control, we've got the connection. Digital's LSI 11/2 and Opto 22's new power I/O are in stock at your nearby Hamilton Avnet office.



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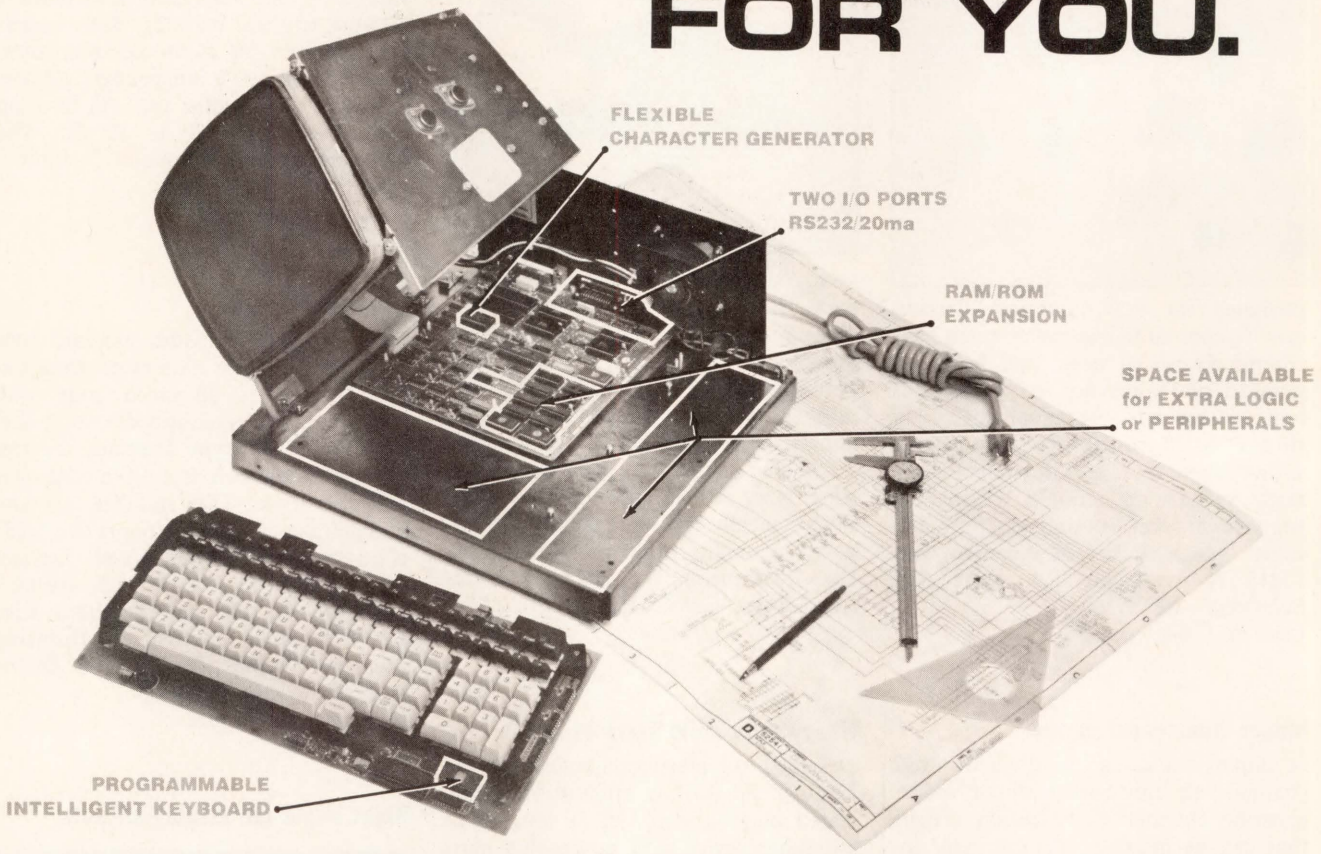
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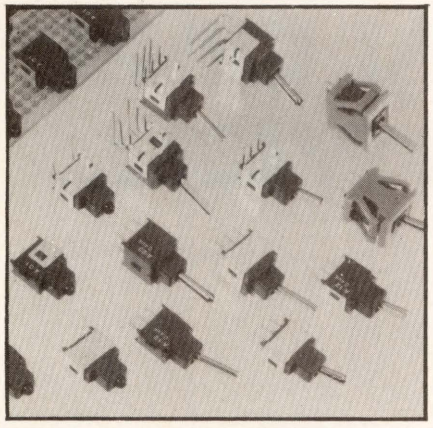
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Florida, Altamonte Springs	(305) 788-9000	**Missouri,** Independence	(816) 356-4402	**Washington, D.C.**	(703) 356-5133

CIRCLE 165 ON INQUIRY CARD

SYSTEM ELEMENTS

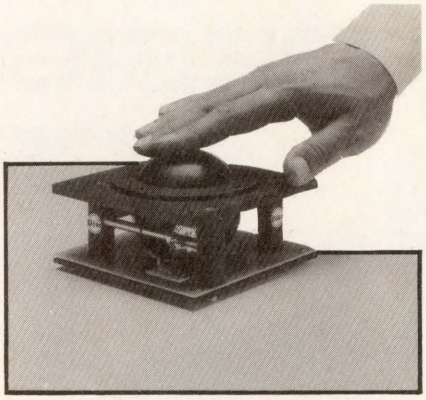
Washable toggle switches



Designed for PCB mounting, Circuitboy™ super-subminiature switches have completely sealed body that is impervious to total immersion in common flux removal solvents. Terminal spacing is std 0.1″ (0.25 cm). Switches are offered with 4 toggle types and in straight, right angle, vertical, and straight with integral support bracket mounting configurations. **NKK Switches of America, Inc,** 14415 N Scottsdale Rd, Suite 600, Scottsdale, AZ 85260.

Circle 284 on Inquiry Card

Low cost trackball



RB300, designed with only 3 moving parts, is offered for hand operated interface applications. Providing an X-Y digital output with TTL or CMOS compatibility, device provides accurate positioning of cursor on CRT displays or allows single hand control of complex automated fabrication equipment. Joystick type devices and their required ADCs typically can be replaced with this device. Quantity price is less than $200. **Disc Instruments, Inc,** 102 E Baker St, Costa Mesa, CA 92626.

Circle 286 on Inquiry Card

Indoor fiber optic cables

FL duplex cables can be divided into 2 channels; exterior cable-coding provides accurate channel identification. Fibers that can be inserted into the cable include large core PCS fiber with 200- or 250-micron core; short distance GI fiber with 100-micron core; and high bandwidth, low lost GI fiber with 50-micron core. Cable is available in continuous lengths up to 1 km or pre-cut to specified lengths, with or without installed connectors. **Fibronics LTD, M T M Advanced Technology Center,** Haifa 31905, Israel.

Circle 285 on Inquiry Card

Heavy duty solid state relays

Designed to replace mechanical relays in heating and cooling applications, solid state relays consist of a single-pole switching device with no moving parts and are capable of several million operation cycles. By applying a control signal, the relay provides zero voltage switching for 120- to 240-Vac applications. Six models are available, 3 for ac input control signals and 3 for dc signals. Each set has nominal ratings of 10, 25, and 45 A and is designed for severe duty. **Omega Engineering, Inc,** One Omega Dr, Stamford, CT 06907.

Circle 287 on Inquiry Card

High performance op amps

μPC254 instrumentation op amp features low offset voltage, bias current, and noise, combined with high gain, input impedance, common mode rejection ratio, and supply voltage rejection ratio. μPC354 monolithic ultralow offset voltage op amp adds an offset trimming network to these features. Both models are provided in 8-pin ceramic DIPs. μPC454 combines 2 independent μPC354s in one 14-pin ceramic DIP. All have op temp range of −20 to 80 °C. **NEC Electron, Inc,** 252 Humboldt Ct, Sunnyvale, CA 94086.

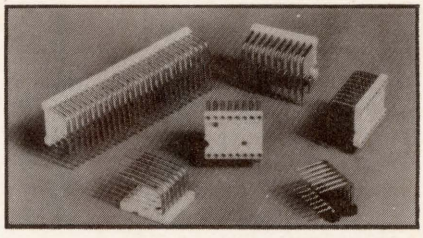
Circle 288 on Inquiry Card

Data separators

Data Express/1 provides standard MFM coding and 5-MHz data rates. Data Express/2 handles advanced code with custom VLSI encoder/decoder ICs. Using standard SA1000 type interface, devices are linked between disc drive controller and disc drives. They stabilize raw data at high data rates and support two 5.25″ (13.34-cm) Winchester drives. Devices are contained on a 7.75 x 5.5″ (19.69 x 14.0-cm) PCB that mounts within drive or controller enclosure. **Rotating Memory Systems, Inc,** 1031A Duane Ave, Sunnyvale, CA 94086.

Circle 289 on Inquiry Card

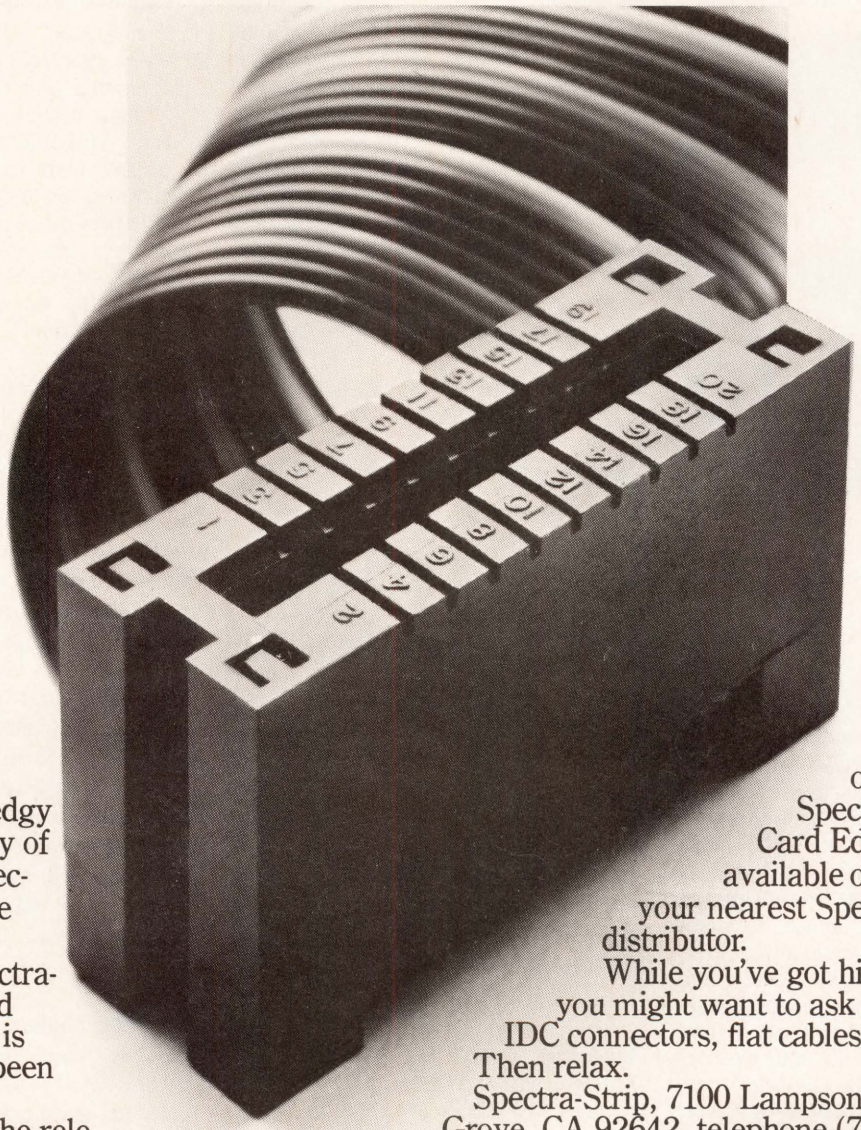
Right angle LED display sockets



Series 500 and 501 pluggable, modular sockets are designed for vertical or horizontal mounting of 8- through 40-lead numeric or alphanumeric LED displays. Units feature precision contacts for greater reliability; brass terminals with optional tin plating; and SE-O grade thermoplastic contact body with polarization notches. Sockets are available in variety of contact spacings and configurations. **Garry, Div of Brand-Rex Co,** North Brunswick, NJ 08902.

Circle 290 on Inquiry Card

Advantedge



If you've been edgy about the quality of your PCB connectors, here's some good news:

The new Spectra-Strip™ IDC Card Edge connector is the one you've been waiting for.

Designed to the relevant portions of MIL-C-83503 and MIL-C-21097, the 807 Series is priced so that you can improve performance in even your most cost-sensitive systems.

With it, you can *reliably* terminate up to 60 wires at a time using our Twist 'N' Flat,® 3C® Color Coded and economical Spectra-Zip® cables. PCB contacts are bifurcated for reliability, you have a choice of three mounting configurations and covers are easily removable for daisy-chaining (cover removal tool optional).

And maybe best of all, the Spectra-Strip 807 Card Edge connector is available off-the-shelf from your nearest Spectra-Strip distributor.

While you've got him on the line, you might want to ask about our other IDC connectors, flat cables and assemblies.

Then relax.

Spectra-Strip, 7100 Lampson Ave., Garden Grove, CA 92642, telephone (714) 892-3361 and 720 Sherman Ave., Hamden, CT 06514, telephone (203) 281-3200.

In Europe, Spectra-Strip, Ltd., Romsey, Hampshire, England, telephone (0794) 517575.

Call now for the name of your nearest distributor.

When you're down to the wire.

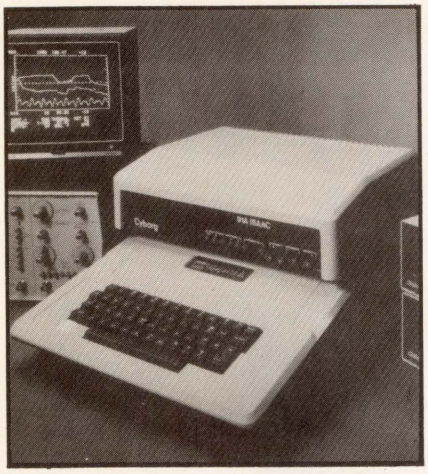
SPECTRA-STRIP

An ALLIED Company

CIRCLE 166 ON INQUIRY CARD

CONTROL & AUTOMATION

Data acquisition system converts Apple into realtime control system



Combined with an Apple II Plus computer, ISAAC (Integrated System for Automatic Acquisition and Control) provides realtime computer control of laboratory instruments, data acquisition, automated test setups, process control, and front-end processing for larger systems. The system includes encased I/O hardware, LABSOFT extended BASIC software, and step-by-step user instruction.

Major system features include a 16-channel, 12-bit ADC; 4-channel, 12-bit DAC; 4 programmable Schmitt triggers; 16 binary outputs and 16 binary inputs with complete handshaking capability; built-in reference voltages; 16-bit timer; 16-bit, 8-channel counter, with 10-MHz maximum frequency; and realtime clock. LABSOFT system software is an extension of Applesoft BASIC, specifically designed to facilitate data acquisition programming. System users can also program in FORTRAN or Pascal and add IEEE 488 and RS-232 interface cards. Graphics extensions enable the user to represent data as color graphs and charts. Statistical analysis programs are available for the manipulation of experimental data.

For application flexibility and portability, the ISAAC case is detachable from both the computer and the ISAAC instrument connection panels. The Apple can also be easily disconnected for separate word processing, accounting, and personal use. System price is $7250 complete with Apple II, disc drives, and color monitor, or $3950 as an add-on to an existing Apple system. **Cyborg Corp,** 342 Western Ave, Boston, MA 02135.

Circle 291 on Inquiry Card

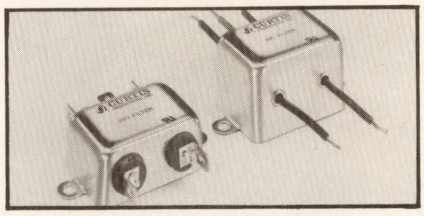
Robot vision module

Model 4200, a combination of the model 2000 video image analyzer and a high level image analysis software module, is a programmable vision system that locates an object's position or orientation to guide an industrial robot. Device can also perform noncontact visual inspection. Module compares object's features with reference standard and reports defects. It can also measure object's size, area, and perimeter, and locate or count objects and holes. **Octek Inc,** 7 Corporate Pl, S Bedford St, Burlington, MA 01803.

Circle 292 on Inquiry Card

EMI PROTECTION

Rfi noise filters



Series F1100 filters are designed to help solve power line rfi problems in data processing and other electronic equipment. Filters are available in 3-, 6-, or 10-A models, 115/250 Vac, 50/60 Hz, to match specific noise emission requirements. Designed with wire leads or quick connect terminals, filters provide fit, form, and function interchangeability with competitive units. **Curtis Industries, Inc,** 8000 W Tower Ave, Milwaukee, WI 53223.

Circle 293 on Inquiry Card

3-phase, 10- to 20-A EMI filters

Designed for U.S. and Canadian equipment using Delta-connected power distribution systems, TD and LD devices incorporate 3 filters, one for each phase, and a 100-μH inductor for optional ground current isolation; TY and LY series devices have 4 filters, one for each phase plus neutral mode, with 100-μH conductor. Current ratings are 10, 15, and 20 A, with line-to-line voltage rating of 250 Vrms. **Genisco Technology Corp, Components Div,** 18435 Susana Rd, Rancho Dominguez, CA 90221.

Circle 294 on Inquiry Card

EMI shielding conductive compounds

Premi-Glas^R esd-emi compounds provide electrostatic discharge characteristics and emi shielding properties without using a secondary coating process. Available in Premi-Glas BMC, SMC, or TMC form for injection, transfer, or compression molding, compounds provide thermal conductivity up to 10 times greater than conventional SMC. Price range is $2 to $3/lb ($0.90 to $1.35/kg), depending on degree of shielding required. **Premix, Inc,** North Kingsville, OH 44068

Circle 295 on Inquiry Card

Miniature filter pin connectors

MIL-C-26482 type series 81009 connectors, with tin over nickel plating, and series 81019 connectors, with class "W" (olive drab cadmium) plating, have bayonet coupling, jam nut mounting receptacles that intermate with MIL-C-26482 series 2 and MIL-C-83723 series 1 plugs. Environmentally sealed connectors use rear release dielectric contact retention system. Low-Pass, PI-network ferrite capacitors, in contact sizes 12, 16, 20, and 22, filter unwanted signals. **The Deutsch Co, Electronic Components Div,** Municipal Airport, Banning, CA 92220.

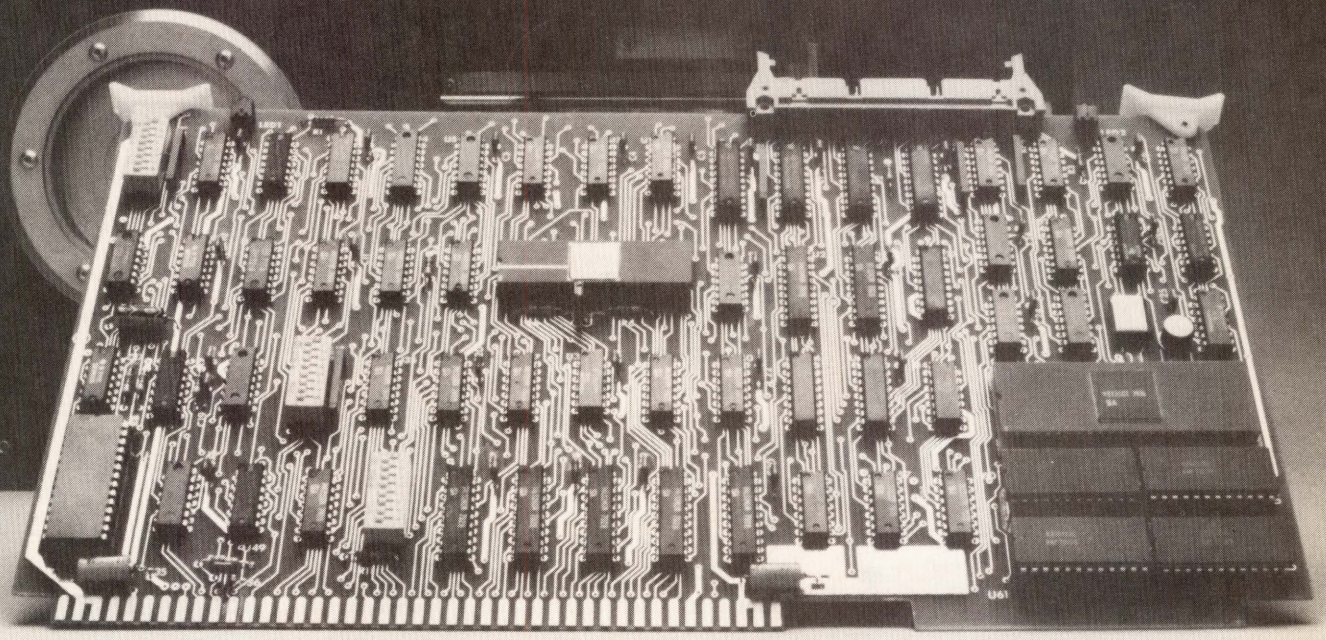
Circle 296 on Inquiry Card

Shielded chokes

Chokes effectively attenuate the transfer of unwanted disturbances from one circuit to another, providing a simple means of eliminating rfi and emi. Inductance ranges from 250 μH to 1 H, with saturation currents up to 1.33 A. Leads are tinned for ease of soldering and are epoxy secured. Chokes are centered on lead wires or can be supplied reel taped. Devices are suited for high density packaging in applications such as telecommunications, power amplifiers, low level power supplies, and SCRs. **Cramer Coil, Div of Digital Magnetics, Inc,** 1121 15th Ave, Grafton, WI 53024.

Circle 297 on Inquiry Card

The little guys have done it again.



PRESENTING THE FIRST ANSI WINCHESTER DISK CONTROLLER FOR MULTIBUS.™ AVAILABLE TODAY. FROM INTERPHASE.

The WDC 2880 is an Intelligent Controller for up to 8 ANSI X3T9.3 compatible Winchester drives. It gives your MULTIBUS system true performance.

Hardware ECC, Automatic Error Recovery, Sector Interleaving, Bad Track Mapping, and Overlapped Seeks mean High Performance on the Disk side.

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You've come to expect high quality innovations first from Interphase. The most talented Intelligent Disk Controller specialists in the country. And the WDC 2880 is no exception. It is elegant, well designed, affordable and available off the shelf.

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CIRCLE 167 ON INQUIRY CARD

Does off-the-shelf power supply delivery always mean 6 to 8 weeks?

Not with Sierracin power systems.



Like you, we build to customer orders. And, like you, we adjust production schedules to make customers happy. But we also build extra so we can ship to customers who need them now. We call it "inventory buffer." Industry calls it "off-the-shelf."

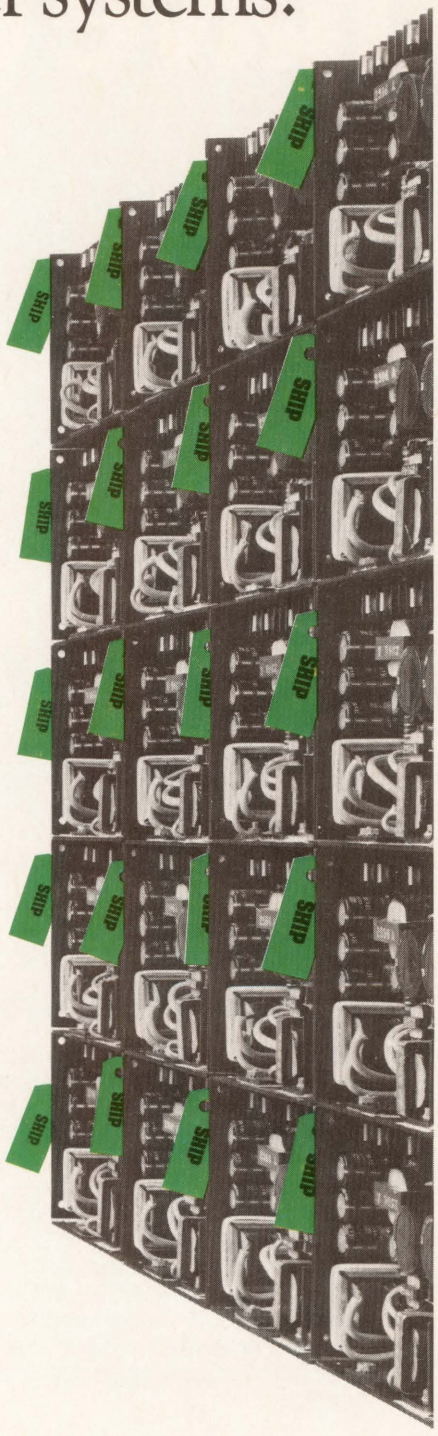
Sierracin's off-the-shelf means selection, too. We've got the widest line of 40-500 watt switchers starting at $45. And our linears cross-index with everyone else's. They start at $19 and include OVP at no extra cost.

But fast delivery from us is not enough. We also think fast out-*your*-door is equally important. That means having power supplies that work the first time—every time—you put them in your system.

Our switchers have a wide AC input range with tightly regulated outputs. This means no line transient problems, brownouts, cross-regulation, or unexplained system crashes.

In short, we ship power supplies fast, affordably, and reliably. It's what you can expect from Sierracin/Power Systems. A young, dynamic company that's already a recognized industry leader after six short years.

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CIRCLE 177 ON INQUIRY CARD

7.3 to 83 Megabytes

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- ANSI, SMD and FLOPPY interfaces.
- Capacities of 7.3, 22, 36.7, 52 and 83 megabytes.
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Woodland Hills, Calif. 91367 / Phone: (213) 884-7300 / TWX: 910-494-2696

CIRCLE 168 ON INQUIRY CARD

PERIPHERALS

Smart CRT with security card reader protects computer files



A smart video display terminal with a magnetic stripe card reader keyboard, 630C protects confidential computer files through error-free computer authorization. The terminal requires each operator to have a magnetic stripe card containing user identification and security level codes. To provide security, ASCII data is read from the card, sent to the CPU, and stored in the terminal's memory.

Available with a tilt swivel mechanism, the ergonomically designed terminal has a 12″ (30-cm) screen that displays 25 lines of 80 chars in a 6 x 8 dot matrix in an 8 x 10 field (a 7 x 9 dot matrix in a 9 x 11 field is also available).

The terminal's detached keyboard with numeric pad has a typewriter layout with 81 keys, typematic (auto repeating) after 0.75 s, and six function keys capable of generating sixteen 2-char code sequences. The device also offers separate cursor control and edit cluster; software controlled lock/unlock; and local and remote TTY clock control keys. Full editing capabilities, selectable automatic line feed on carriage return, page or rollup operation, auxiliary user programmable port, diagnostic loopback test and fill screen test, and user programmable horizontal split screen are provided as well.

Switch-selectable features include 8 data transfer rates from 110 to 9600 baud; 10- or 11-bit serial asynchronous ASCII data with odd, even, or mark parity; EIA RS-232-C interface; half or full duplex; line, page, and partial page transmit; X-ON/X-OFF; and protected fields with transmit of all data or unprotected data only. Quantity 1 end-user price is less than $2000; OEM pricing is available. **TEC, Inc,** 2727 N Fairview Ave, Tucson, AZ 85703.

Circle 320 on Inquiry Card

Ultra-high resolution 19″ color monitor

HM-3619 features RGB convergence specs of 0.1 mm at CRT center, and elsewhere to within 0.3 mm. RGB convergence is factory set and requires no adjustment due to temperature or other environmental conditions. Pixel resolution is 1024 (vertical) and 1280 (horizontal), and video bandwidth is up to 40 MHz. Color picture tube, with "inline triodot," has pitch of 0.31 mm. **Hitachi America, Ltd,** 6 Pearl Court, Allendale, NJ 07401.

Circle 321 on Inquiry Card

User installable graphics conversion package

Model VT6405 enables DEC's VT100 alphanumerics terminal to perform as both an alphanumeric and a graphics terminal capable of emulating Tektronix 4010 series graphics terminals. Operational features include vector drawing, point plotting, mode-independent selective erase, std cross-hair cursor, and optional lightpen and printer interface. Cross-hair cursor and lightpen permit emulation of Tektronix 4010 graphic input mode. **Digital Engineering, Inc,** 630 Bercut Dr, Sacramento, CA 95814.

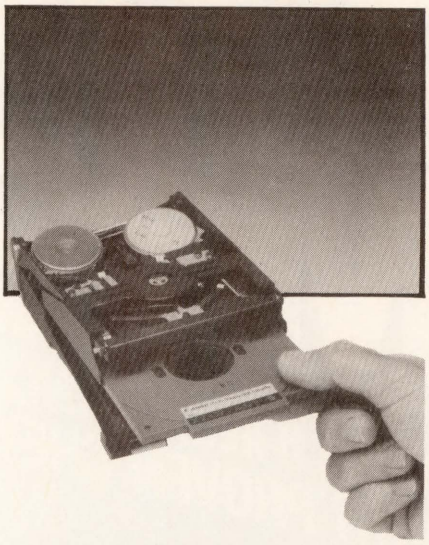
Circle 322 on Inquiry Card

Centronics compatible daisywheel printer

D-50C is capable of automatic bidirectional printing at 47 chars/s. Std output is 10 chars/in (4/cm), horizontal pitch, and 6 lines/in (2.4/cm) vertical spacing for 11″ (28-cm) forms. Series of escape codes sent over interface can change pitch to either 12 or 15 chars/in (4.7 or 6/cm), or line spacing to 8 lines/in (3/cm). Unit uses std 96-char plastic printwheels and is available with uni- or bidirectional tractor feed, or single-bin sheet feeder. **Dataproducts Corp,** 6200 Canoga Ave, Woodland Hills, CA 91365.

Circle 323 on Inquiry Card

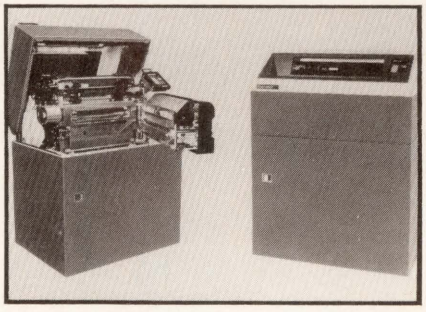
Micro floppy disc drive



Drive uses cassette with recording capacity of 512 bytes/track on 16 tracks, for a total of 8.192k bytes on a single side. Encoding method is FM, recording density is 698 bits/in (275/cm), and track density is 25.4 tracks/in (10/cm). Media rotation speed is 100 r/min and data transfer rate is 8.33k bits/s. Power required is 5 and 12 Vdc ±5%. Device measures 4.25 x 6 x 1.88″ (10.79 x 15 x 4.77 cm) and weighs 25 oz (0.7 kg). **Canon USA, Inc, Electronic Components Div,** One Canon Plaza, Lake Success, NY 11042.

Circle 324 on Inquiry Card

890- to 1440-line/min printers



QT-12 prints 890 lines/min with a 96-char set, 1200 lines/min with a 64-char set, and 1440 lines/min with a 48-char set. Features include operator changeable bands, swing-open band gate, diagnostic display, membrane touch controls, form length select switch, 6 or 8 lines/in (2.4 or 3.1/cm), and casters. Other features include towel ribbon with deskew, forms/alignment and column scale, and paper motion verification. **Southern Systems, Inc,** 2841 Cypress Creek Rd, Fort Lauderdale, FL 33309.

Circle 325 on Inquiry Card

BEST OF BOTH



WINCHESTER TECHNOLOGY, FLOPPY REMOVABILITY

LYNX

Only the LYNX offers the expanded capacity and outstanding performance of Winchester hard disk technology for your small business computer or word processing system. With the removability and convenience of the floppy disk drives you're now using.

The DP100 LYNX disk drive from Data Peripherals features a *removable* disk cartridge that packs 11 megabytes of memory into the same space as a standard 8-inch floppy drive. That's 10 to 20 times more storage combined with superior performance and reliability.

Add the DP900 intelligent controller, and you've got a complete OEM package which you can design into your system. Quickly, easily, and economically.

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We know it takes more than specs to win your business. That's why we've built our manufacturing, quality control, and support organization around the needs of the toughest customer of all. You, the OEM.

We're ready now, with production units in the quantities you need. Call or write today for full information on the LYNX.

And keep a step ahead of your competition.

Data Peripherals

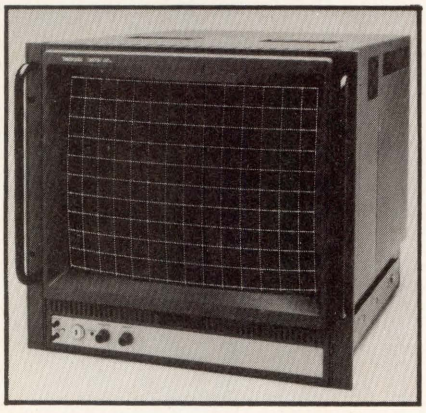
965 Stewart Drive, Sunnyvale, CA 94086, (408) 745-6500

A subsidiary of CCT

CIRCLE 169 ON INQUIRY CARD

PERIPHERALS

Color monitor offers delta gun dot shadowmask picture tube



A 19″ (48-cm) high performance monitor, 690SR option 42 features a high resolution delta gun dot shadowmask color picture tube, wide range scan circuits, and excellent color convergence. Efficient power supplies, modular construction, ease of alignment, and durability increase the monitor's dependability and useful life. Plug-in interface modules meet various user requirements.

The CRT has 0.31-mm dot triad spacing that provides more than 1300 horizontal elements and more than 1800 vertical resolution elements in each color. Wide range deflection circuits produce more than 1200 horizontal scan lines (interlaced) or more than 600 lines (noninterlaced) at 30- or 60-Hz frame rates, respectively. The main video amplifier features full amplitude response (rise or fall times) of less than 14 ns. Convergence accuracy is maintained over the entire screen, with a max error at any point of 0.5 mm. A simplified color coded control panel allows readjustment of convergence. Display size and aspect ratio are also adjustable within a lockable front control drawer.

A plug-in interface module accepts RGB input signals with either separate or composite sync (RS-170A/RS-343) on the green channel. Input impedance is 75Ω with switchable terminations. Signal levels are standard 0 V for black and 0.7 V for high light level.

Monitor measures 44.35 x 48.26 x 57.94 cm and weighs 50 kg. **Tektronix, Inc,** PO Box 500, Beaverton, OR 97077.

Circle 298 on Inquiry Card

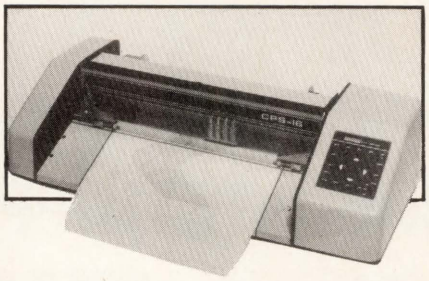
Low cost intelligent terminal can be customized

Based on the 8085 microprocessor, ZMS-35 is a low cost, customizable intelligent terminal with 16k-bytes of user RAM, a fully configurable keyboard, a 12″ nonglare CRT and a 128-char set. The terminal has a flexible, minicomputer-like bus architecture for efficiency and flexibility.

Applications for the intelligent terminal are seen in forms entry, where many forms can be downline loaded from the host computer for standalone processing at the terminal workstation. Special CRT features support information processing. The terminal is capable of performing special functions, such as split screen format with independent scrolling of data. Interfaces include RS-232-C for operation up to 9600 baud, and 20 mA current loop at speeds up to 19.2k baud. Key options include printer interface, downline loader, and debugger for user software development. **ZENTEC Corp,** 2400 Walsh Ave, Santa Clara, CA 95050.

Circle 299 on Inquiry Card

4-pen tabletop drum plotter



Microprocessor based CPS-16 produces 4-color drawings in sizes A, B, C, and D on paper, mylar, or vellum. It accepts data from either std EIA RS-232-C or 20-mA current loop data source and operates in online or remote timeshare environments. Plotter features up to 172 firmware generated characters containing both upper and lowercase letters, positive paper feed, circular buffer memory, and protocol for detection and correction of data transmission errors. Touch selectable writing speed is 10 or 15″ (25 or 28 cm)/s. Resolution is 0.002″ (0.05 mm). **Houston Instrument,** 1 Houston Sq, Austin, TX 78753.

Circle 326 on Inquiry Card

Realtime image processing system

Trapix series systems feature single- or multichannel image display resolution of 256 x 256 to 1024 x 1024 x 16 bits. Arithmetic Pipeline Image Processor (PIP) provides up to 256-frame averaging, continuous subtraction, 9-bit linear/log video digitizer, and input video formatting. Std features include an EIA std 19 x 5.25″ (48 x 13-cm) rack-mountable system enclosure, Q-bus interface with interconnecting cables, memory management, image display controller, image magnification, X-Y scroll, and realtime image windowing. **Recognition Concepts, Inc,** 924 Incline Way, Incline Village, NV 89450.

Circle 301 on Inquiry Card

Bidirectional dot matrix printer

Pedestal mounted 3268 prints up to 340 chars/s, accommodates multiple-copy paper up to 16″ (40-cm) wide, and prints in std 10-char/in (4/cm) or condensed 16.7-char/in (6.6/cm) horizontal spacing formats. Variable paper widths and spacing formats are std. Printer provides a total of 22 char sets; most national languages are represented and are operator selectable. An APL/TEXT char set is available with each language. **International Business Machines Corp, Data Processing Div,** 1133 Westchester Ave, White Plains, NY 10604.

Circle 302 on Inquiry Card

12″ 4-pen digital drum plotter

Model 1453SX desktop plotter offers max speeds of 15″ (38 cm)/s axially, and 21″ (53 cm)/s diagonally, with 0.001″ (0.0025-cm) resolution. Designed for use with continuous feed paper for unattended multiple-plot operation, plotter is equipped with either RS-232 or IEEE-488 interface. Unit includes integral microcomputer based controller, hardware character generator, dot/dash mode, and arc generator. **Nicolet Zeta Corp,** 2300 Stanwell Dr, Concord, CA 94520.

Circle 303 on Inquiry Card

DILOG TAPE COUPLERS FOR STREAMING OR FORMATTED DRIVES FOR DEC 11*

The DILOG DQ130 and DU130 are μP based intelligent ½" Tape Couplers for your LSI-11, 11/2, 11/23 or PDP-11 computers respectively. They're the only Couplers • for standard start-stop or streaming mode operation • capable of handling 8 drives • proven reliability and performance with an installed base *in excess of 1,000 units* • all on a single quad board that plugs into your CPU.

If you intend using your streaming tape drive in a standard start-stop mode and later wish to employ streaming mode for Winchester back-up, DILOG Couplers will handle both. You don't need to change a thing. The Dilog 'Backup/Restore' stand-alone driver software will implement and support streaming operation.

The '130' Series can also accommodate two standard ½" formatted tape drives with three slaves each, or two stand-alone formatters that handle four drives each... 9-track 800 bpi NRZI, 9-track 1600 bpi PE, or 800-1600 bpi dual density... with 7", 8½" or 10½" reels and read/write speeds from 12.5 to 125 ips and data transfer rates to 200,000 bytes per second.

The Couplers emulate the DEC TM-11/TS-03 and you'll get full software compatibility with RT-11, RSX-11, RSTS, IAS and MUMPS.

As for tape drive compatibility, both the DQ130 and DU130 interface drives from the following manufacturers:

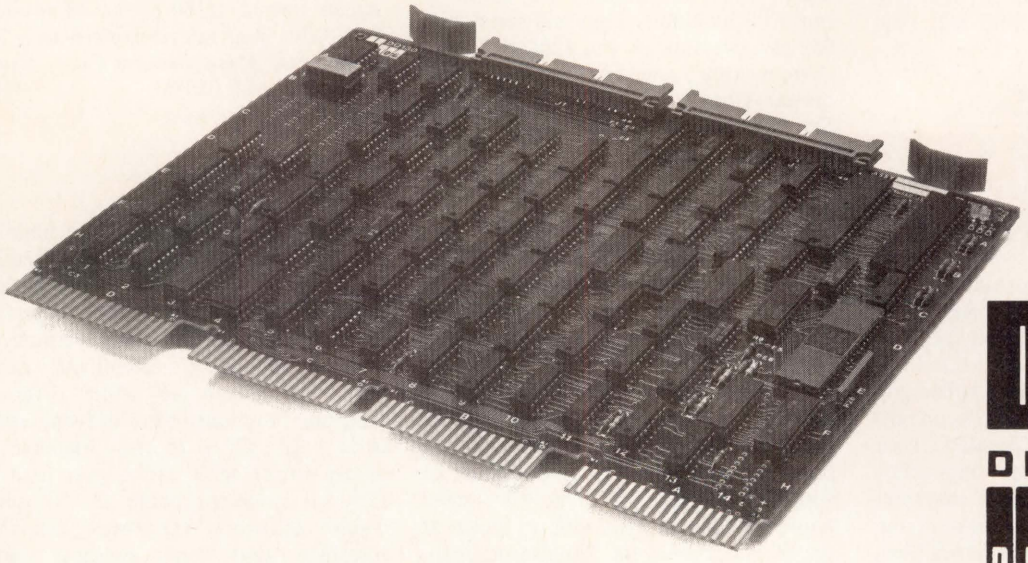
AMPEX	PERTEC
CIPHER	TANDBERG DATA (IDT)
CONTROL DATA	WANGCO (PERKIN ELMER)
DIGI-DATA	TDX
KENNEDY	EMI (SE LABS)

To insure ease of maintainability & data integrity the Couplers incorporate an automatic self-test feature, with card-edge LED status indicator, and data protect feature.

Write or call for complete details on the Coupler that lets you mix or match up to eight ½" tape drives for standard or "streaming" operation.

Distributed Logic Corp., 12800 Garden Grove Blvd., Garden Grove, California 92643 Phone: (714) 534-8950 Telex: 681 399 DILOG GGVE • EASTERN REGIONAL SALES OFFICE, 64-A White Street, Red Bank, New Jersey 07701, Phone: (201) 530-0044.

*Trademark Digital Equipment Corp.



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DILOG

NUMBER 1 FOR DEC-11

CIRCLE 170 ON INQUIRY CARD

PERIPHERALS

16M-byte Winchester drive integrates tape unit for backup

A Winchester disc mechanism for mass storage and a 0.25″ (0.64-cm) cartridge tape drive for personal I/O and backup are combined in the HP 7908 16M-byte integrated disc/tape drive. Offered for the company's computers, the unit also includes an integral controller that manages most drive operations, and test and diagnostic features that reduce maintenance costs.

The unit's fixed disc mechanism has an average access time of less than 50 ms and transfers up to 537.6k bytes/s. The tape unit transfers up to 35k bytes/s, allowing an image copy backup of an entire disc in less than 10 min.

Most disc and tape operations, including disc to tape (backup) and tape to disc (restore) data transfers are managed, without system intervention, by the unit's intelligent integral controller. The controller can also manage selective file backup through system supplied software. Internal verification test automatically occurs at power-on and provides functional test of the system to the replaceable assembly level. Diagnostics can be started online under system control, offline under local control, or remotely via a modem.

The drive is available in two packages: a rackmounted version for technical applications and a standalone cabinet for office environments. List price is $9900 ($7900 without tape unit). **Hewlett-Packard Co,** 1507 Page Mill Rd, Palo Alto, CA 94304.

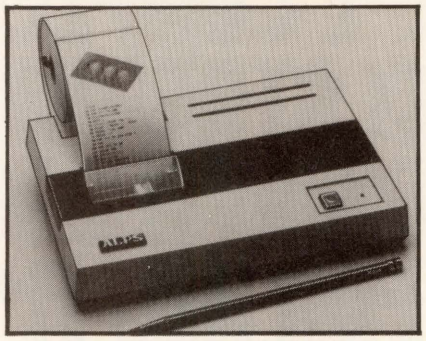
Circle 304 on Inquiry Card

240-char vacuum fluorescent display

Incorporating features of previous FLIP model displays, 240-char module features 6-line x 40-col format and full 96-char ASCII font with European ECMA-7 overlays. Unit also accepts user defined chars in any or all ASCII locations. Data can be vertically scrolled and can be entered beginning at top or bottom line, or randomly located. User selects automatic carriage return/line feed or overwrite of rightmost character end of line mode. Module operates from single 5-V power supply. **Industrial Electronic Engineers, Inc,** 7740 Lemona Ave, Van Nuys, CA 91405.

Circle 305 on Inquiry Card

Microminiature alphanumeric graphics printer



Printer uses specially designed ballpoint pen to produce alphanumeric and graphic symbols on std 2.28″ (5.79-cm) roll paper. Model 1200 uses 4 different colored pens to create 4-color graphics. It prints alphanumerics in 15-, 18-, 24-, and 36-col sizes and writes 6 chars/s in smallest size. Model 1100 uses single pen and creates alphanumerics in sizes from 40 to 10 cols/line. It writes 12 chars/s in smallest size. Characters in 36 (4-color)/40 (single-color) column size measure 0.059 x 0.038″ (0.150 x 0.097 cm). **Alps Electric USA, Inc,** 100 N Centre Ave, Rockville Centre, NY 11570.

Circle 306 on Inquiry Card

Apple II compatible dot matrix printer

Model 170 provides 18- or 21-char/line, 6-line/in (2.4/cm) print density, on standard 2.25″ (5.72-cm) adding machine tape. Std features include internal 3-line buffer, switch selectable ASCII or Baudot input code, upper- and lowercase chars, and internal clock and calendar. 115/230 Vac, 50/60 Hz is std and 12-Vdc power option is available. Optional serial port for RS-232-C data or TTY (20- or 30-mA current loop) will be available. **Addmaster Corp,** 416 Junipero Serra Dr, San Gabriel, CA 91776.

Circle 307 on Inquiry Card

High performance CRT monitor

VR-1000 runs at horizontal scan rate of 64 kHz, generating a noninterlaced raster of 1024 lines with a refresh rate of 60 Hz. Monitor provides 100-line/in (39/cm) resolution in both vertical and horizontal dimensions. Displays can be 66 lines x 80, 96, or 132 chars. At the pixel level, video has a rise/fall time of 4 ns. Either P-4 white or P-31 green phosphors can be used with no flicker at the 60-Hz frame rate. **Moniterm Corp,** 7180 Shady Oak Rd, Eden Prairie, MN 55343.

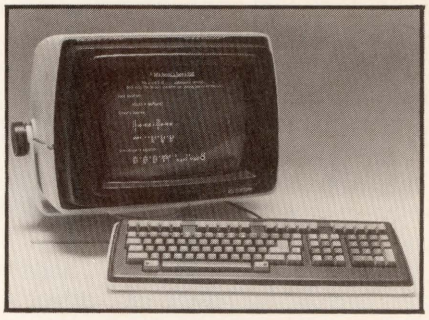
Circle 308 on Inquiry Card

Graphic display CRT

M38-200 resolves 3.9M pixels in nominal 15″ (38-cm) diagonal format and displays over 8000 alphanumeric characters. Minimum useful scanning area is 7.88 x 10.63″ (20 x 27 cm), permitting full-scale display of all copy and/or graphics contained on a std 8.5 x 11″ (21.6 x 28-cm) sheet of paper. Type AT1991 deflection coil produces only negligible distortion and deflection defocussing, eliminating all raster pincushion effects. CRT is available with both P-4 white and P-31 green phosphors. **Amperex Electronic Corp, Slatersville Div,** Slatersville, RI 02876.

Circle 309 on Inquiry Card

8-color alphanumeric display terminal



DASHER® DC280C features 2 sets of user definable characters that provide 128 symbols in addition to terminal's 128 upper/lowercase ASCII chars, plus 7 alphanumeric char sets for international use. Detachable keyboard contains typewriter style main keyboard, 14-key numeric keypad, 12-key screen management keypad, 15 program function keys, and 5 operator function keys. Display measures 13″ (33 cm) diagonally and has screen format of 80 cols x 24 rows. A 5- x 9-dot char matrix is used in a 7- x 10-dot cell. **Data General Corp,** Rte 9, Westboro, MA 01581.

Circle 310 on Inquiry Card

Graphics tablet

Allowing Apple II computers to function as a medium for electronically creating and displaying pictorial information, tablet and pen connect to tablet interface card that plugs into peripheral connector slot in computer. Command boxes across top front of tablet offer 22 separate functions. Max drawing space is 11 x 10″ (28 x 25 cm). Package includes tablet with cable, pen with 6′ (1.8-m) connector cable, 2 "Graphics Tablet Software" Diskware diskettes, interface, and mylar overlay. **Apple Computer,** 10260 Bandley Dr, Cupertino, CA 95014.

Circle 311 on Inquiry Card

"Quantum fully intends to be the leader in 8-inch Winchester drives by 1982."

—Jim Patterson, President, Quantum Corporation

We have the very best people. People whose impressive credentials inspired a level of financial backing seldom seen in a company so young. A management team with 110 years' experience and 20 patents in computer peripherals. The same people who developed the first generation of low-cost Winchester drives. And the second. People who have demonstrated the ability not only to design a superior drive, but to produce it. In high volume. At low-cost. So you can count on reliable delivery of high-quality drives . . . always at a competitive price!

The very best drives. Our Q2000 series of 10, 20, 30 and 40-megabyte drives gives you up to four times the capacity of the current industry standard, at a lower cost-per-megabyte. And all four are compatible with standard 8-inch floppy disk drive form factor and power supplies.

Major OEMs have already given the Q2000 series their highest vote of confidence: orders. To stay competitive in today's exploding market for high-quality, low-cost computer systems, you need to know about Quantum's 8-inch Winchester drives now.

For details, call our Western Region Sales Office at (408) 262-1100, or our Eastern Region Sales Office at (603) 893-2672. Quantum Corporation, 1804 McCarthy Blvd., Milpitas, CA 95035.

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CIRCLE 172 ON INQUIRY CARD

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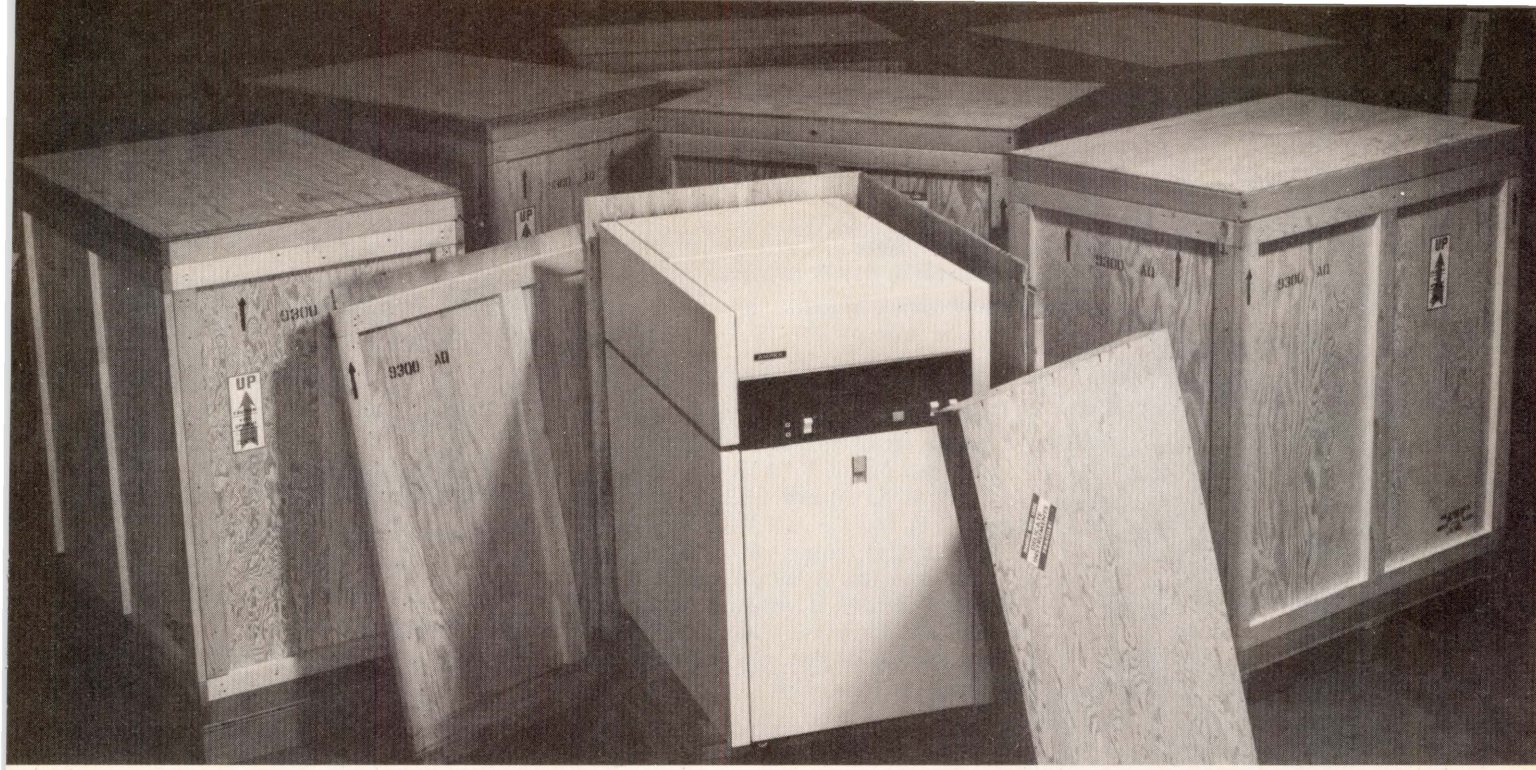
ADAC offers the widest selection of function cards and complete systems for LSI-11. Both analog and digital.

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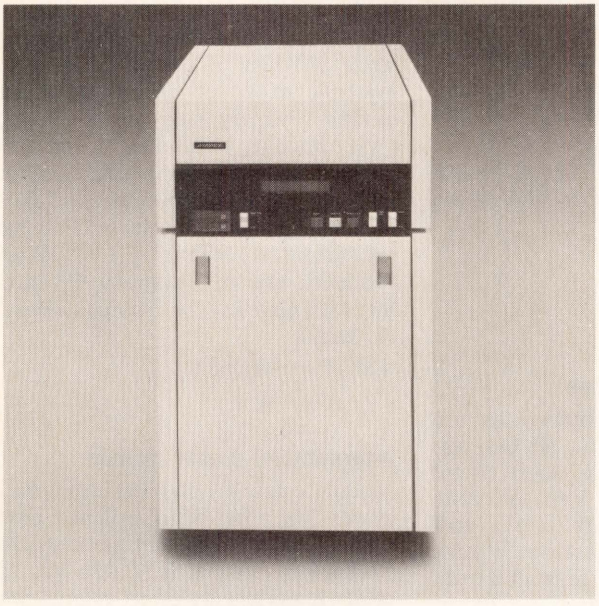
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CIRCLE 161 ON INQUIRY CARD



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You won't, with our CDC 9766 plug-compatible and media-interchangeable drive. It's available when you need it, with excellent delivery times that enable you to meet your own completion and installation deadlines.

Our 9300 AQ 300-megabyte disk drive is housed in a quietized foam-insulated enclosure that is perfect for office environments. Design permits data to be written and read by either Ampex or CDC drives. Standard features include SMD-compatible interface and single port daisy chain interface (dual port available as an option). Trouble-shooting is easy as possible: LED indicators, and easy access top, front and rear. We've also provided for easier pack installation with our front lid design.

We know nothing's more frustrating for a systems integrator than waiting for a drive. With Ampex, now the waiting's over.

For more information, contact Gary Owen, Ampex, Memory Products Division, 200 N. Nash St., El Segundo, California 90245. (213) 640-0150.

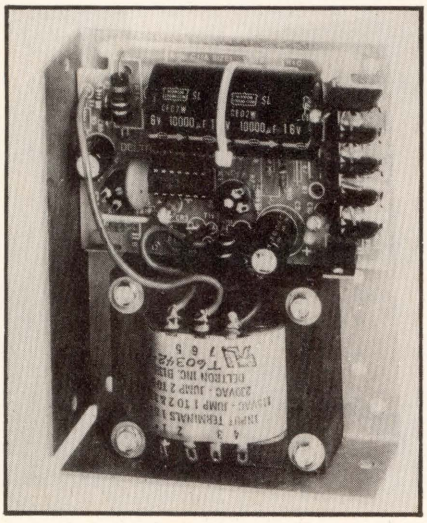
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CIRCLE 173 ON INQUIRY CARD

POWER SOURCES & PROTECTION

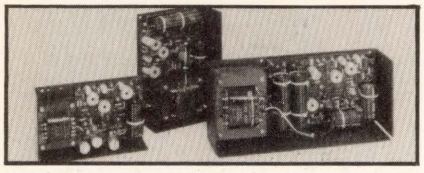
Linear open frame power supplies



HVQ high volume series power supplies feature shielded transformer, socketed semiconductors, dual ac input, barrier block terminals, and MTBF of up to 100,000 h. Input ratings are 105 to 125/210 to 250 Vac; 47 to 440 Hz; and outputs are 5 V at 3 A, 12 V at 1.7 A, 15 V at 1.5 A, and 24 V at 1.2 A, adjustable ±5%. All 5-V models have built-in fixed crowbar overvoltage protection; accessory adjustable crowbar overvoltage protection is available for 12-, 15-, and 24-V models. Single-unit price is $21. **Deltron Inc,** Wissahickon Ave, North Wales, PA 19454.

Circle 312 on Inquiry Card

Dual-output linear power supplies



Six models in series feature built-in overvoltage protection on all 5-V outputs (other outputs use optional overvoltage protection module), and dual 115/230-Vac operation for foreign and domestic operation. Each model also features 30-μs transient response for a 50% load change, output ripple of 3 mV pk-pk max, and current/limit foldback for overload protection. **Microcomputer Power, Inc,** 2272 Calle de Luna, Santa Clara, CA 95050.

Circle 313 on Inquiry Card

Multi-output switching power supplies

SCFL series includes units with output power levels of 15, 25, and 40 W that operate over a 90- to 130-Vac input range with line regulation of 0.05%. Input frequency can be 47 to 440 Hz. Six models are offered with output voltage combinations of 5 V at 2, 3.5, and 5 A; −5 V at 0.5 A; and ±12 or ±15 V at 0.5, 1.0, and 1.5 A. Load regulation is 0.3% for 5-V output and 0.5% for other outputs up to 1-A output current. Overload protection is provided on all outputs. **KEC Electronics, Inc,** 19300 S Vermont Ave, Gardena, CA 90248.

Circle 314 on Inquiry Card

Open frame switching power supplies

SX, SXD, and SXT Simflex 1-, 2-, and 3-output units are rated 50, 60, and 75 W, respectively, with dual input voltage std. All outputs are fully regulated and feature constant current limiting; auxiliary outputs have thermal overload protection. Overvoltage protection is std on main output. Ripple and noise are rated at 1% rms and 4% pk-pk. Units meet European safety standards, as well as UL 478 and CSA, and operate over temp range of 0 to 40 °C. **Gould, Inc, Electronic Power Supply Operation,** PO Box 80878, San Diego, CA 92137.

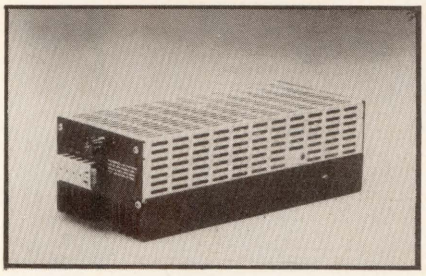
Circle 315 on Inquiry Card

500-W switching regulated power supplies

RSF series fan-cooled switchers feature overvoltage protection on all outputs, foldback current limiting, short circuit protection, 115/230-Vac selector switch, electronic soft start, and overtemperature protection. RSF500 single-output models range from 2 to 28 Vdc, with output currents from 100 to 18 A. Multi-output supplies have additional outputs from 5 to 28 V at currents from 20 to 2 A. RSF100 series dual-output models offer combination of any 2 voltages from 2 to 28 V at currents from 80 to 14 A. Total power output is limited to 500 W. **ACDC Electronics,** 401 Jones Rd, Oceanside, CA 92054.

Circle 316 on Inquiry Card

200-W switching power supplies



ES200 single-output supply is available in voltage ranges from 5 to 24 V, with current of 40 to 8 A. Unit features selectable input of 90 to 130 Vac or 180 to 250 Vac, 47 to 450 Hz. It is rated at 70% efficiency with op temp of 0 to 40 °C convection cooled, 60 °C with minimum air flow. Price is $199 each, in quantities of 250. **Elpac Power Systems, Div of Elpac Electronics, Inc,** 3131 S Standard Ave, Santa Ana, CA 92705.

Circle 317 on Inquiry Card

Hybrid power supplies

Units combine high efficiency of switch-mode supplies and low output noise levels of linear regulated supplies in single compact package. First supply in series provides 5 Vdc at 3 A and is available in PC or chassis mountable models. Primary side uses "flyback" PWM switching techniques operating in conjunction with linear regulated output with overall efficiency rating of 60%. Line regulation is within 0.05%; load regulation is within 0.1%. **Power Products, Div of Computer Products, Inc,** 2801 Gateway Dr, Pompano Beach, FL 33060.

Circle 318 on Inquiry Card

International power module

Module combines high performance rfi power line filter with primary power switch, fuse holder, and ac connector. Package is rated at 6 A, 250 Vac and meets requirements of all international test agencies. High attenuation, multi-stage filter is compatible with switching power supplies. In a 50-Ω network, it has a 5-dB common mode and 64-dB differential mode insertion loss at 1 MHz. Fuse holder accepts North American 0.25″ x 1.25″ (0.64- x 3.18-cm) or international 5-x 20-mm fuses. **Panel Components Corp,** 335 Tesconi Circle, Santa Rosa, CA 95406.

Circle 319 on Inquiry Card

Quality and delivery are two good reasons to choose Panasonic CRT data displays...

The point is, there are a lot of good reasons to choose Panasonic CRT data display modules. Like a full line of models to choose from. Quality that's built in. Delivery when promised. And a super service program that will put you in "seventh heaven".

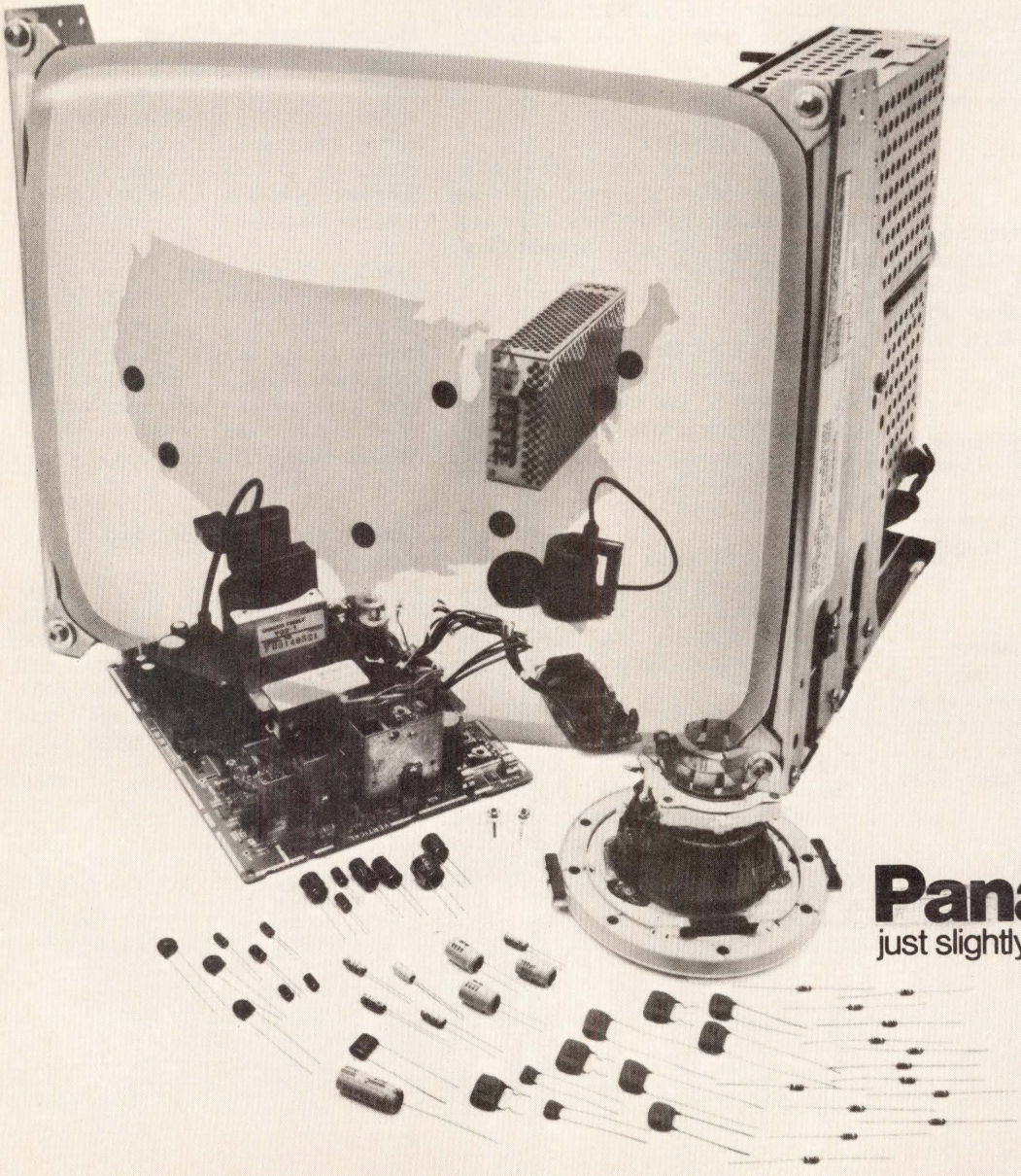
Seven factory servicenters in the U.S. are ready to serve you – either at our facilities or on your site. Component parts for our complete line are available from our Secaucus, N.J. parts depot. And our U.S. Applications and Design Lab is fully equipped to help you with applications, design, testing, troubleshooting and problem solving.



The complete Panasonic line of CRT Data Displays includes high resolution color modules for fine line graphics. A 600-line vertical page reader. And a wide variety of other top-quality color and monochrome CRT chassis assemblies, to give you far-ranging design flexibility.

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CIRCLE 174 ON INQUIRY CARD

Switching, Linear, and Computer Power Supplies

Catalog lists features, specs, options, and ratings for single- to quad-output switchers, single- to triple-output linears, and CP series computer power supplies. **Deltron Inc,** North Wales, Pa.

Circle 227 on Inquiry Card

Interface Converters

IFA series is detailed in brochure featuring adapters that convert RS-232/V.24 interface to either CCITT recommended RS-449, X.20/.21, V.35, or Bell 303. **Atlantic Research Corp,** Alexandria, Va.

Circle 228 on Inquiry Card

VLSI Signal Processing Components

Digital signal processing VLSI devices are described in 4-p, short form catalog that includes word size, multiply time, power dissipation, and package type. **TRW LSI Products,** La Jolla, Calif.

Circle 229 on Inquiry Card

UPS Systems

Illustrated 24-p brochure presents line of UPS systems, details design and theory of operation, offers selection guidelines, and lists electrical/mechanical specs. **Sola Electric,** Elk Grove Village, Ill.

Circle 230 on Inquiry Card

Flexible Disc Unit

Total capability, operating simplicity, and programming flexibility of ENCORE 100 are discussed in bulletin and brochure that provide photos and specs. **Digitech Industries, Inc,** Ridgefield, Conn.

Circle 231 on Inquiry Card

Low Insertion Force Connectors

Listed in brochure are number of available contacts, rated current, and breakdown voltage for Hypertac^{R} line, including modular, miniature, and subminiature units. **Hypertronics Corp,** Concord, Mass.

Circle 232 on Inquiry Card

Statistical Multiplexers

Brochure presents features, benefits, and applications of DCX 836, 840, and 850, along with photos, callout diagrams, and summary of technical information and specs. **Rixon Inc,** Silver Spring, Md.

Circle 233 on Inquiry Card

Software Development System

Flowcharts and photos describe multitasking capability of 9520 system in 4-p brochure. **Millennium Systems,** Cupertino, Calif.

Circle 234 on Inquiry Card

Custom Membrane Keyboards

TOUCH PANEL keyboards are discussed in 4-p brochure that includes exploded view of typical construction and description of operating characteristics. **Cherry Electrical Products Corp,** Waukegan, Ill.

Circle 235 on Inquiry Card

Miniature Switches

Found on catalog sheets are photos, dimensional drawings, specs, operating characteristics, and applications for AH1, AH3, AH4, and AH7 series. **Aromat Corp,** Mountainside, NJ.

Circle 236 on Inquiry Card

FDM/PCM Converter

List of features, system description, block diagram, and technical summary are presented in brochure that discusses type 4691B converter. **GTE Lenkurt Inc,** San Carlos, Calif.

Circle 237 on Inquiry Card

Remote I/O Systems

Information on protocol, communications security, timing, time delay, latching, and counting are provided by SAMUX II catalog. **Opto 22,** Huntington Beach, Calif.

Circle 238 on Inquiry Card

Pushbutton Switches

Range of panel mounted, snap-in, PC mounted, and PC right angle mounted pushbutton switches are described in 20-p catalog of specification details. **Dialight,** Brooklyn, NY.

Circle 239 on Inquiry Card

Permanent Magnet dc Motors

Selection and units conversion tables, performance data, and winding variations for motors and motor tachogenerators are supplied by catalog that includes dimensional drawings and graphs. **Moore Reed and Co Ltd,** Walworth Andover Hampshire, England.

Circle 240 on Inquiry Card

Cardedge Connectors

Catalog for 01 to 06 and 10 series includes features, specs, materials and finishes, assembly and finish codes, polarization keys, dimensions, and cross-reference chart. **Teka Products, Inc,** Woodside, NY.

Circle 327 on Inquiry Card

Microprocessor Software

Catalog describes 6800/6809 software for single-user, multi-user, and network operating systems, as well as BASIC compilers, assemblers, editors, and word processing and accounting software. **Software Dynamics,** Anaheim, Calif.

Circle 328 on Inquiry Card

Leadless Chip Carriers

Included in brochure are table of application areas for components in military, industrial, and medical categories, discussion of testing and support, comparison of screening and lot conformance, and products listings. **Mostek Corp,** Carrollton, Tex.

Circle 329 on Inquiry Card

Transformers, Inductors, and Power Supplies

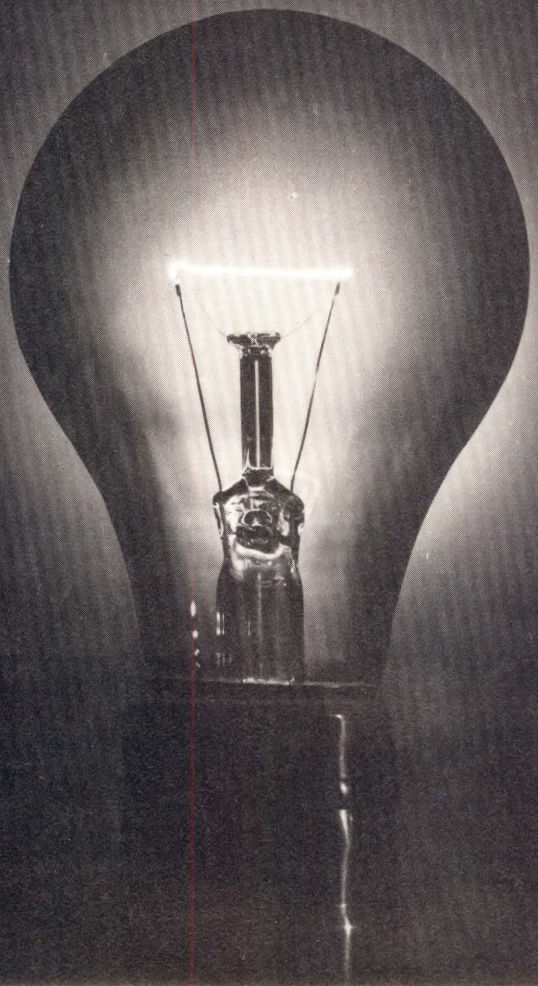
Catalog features Flat Pack^{TM} power transformer, along with filter reactors, dc power supplies, magnetic components, audio transformers, and toroidal inductors, and provides photos, specs, and drawings. **Triad-Utrad Distributor Services,** Huntington, Ind.

Circle 330 on Inquiry Card

In a world plagued by uncertainties, it's comforting to know that some things remain constant. Take Uninterruptible Power Systems (UPS) from Franklin Electric, for example. They're available in 50, 60 and 415Hz versions, with power levels ranging from 50 to 1,000 KVA. But that's not the whole story. When you write for details about our UPS line, be sure to ask about our state-of-the-art efficiencies and quick delivery. And remember: when you need uninterruptible power, let it be from Franklin.

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Circle 149 for Demonstration
Circle 150 for Literature
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LITERATURE

Keyboard Display Card
User's manual for model 7030 STD BUS keyboard display card details main features, installation, specs, operation, programming, operating software, and maintenance, and illustrates front panel mounting. **Pro-Log Corp,** Monterey, Calif.
Circle 331 on Inquiry Card

Technical Training
Two brochures describe wide range of technical training programs available to customers. **Data General Corp,** Westboro, Mass.
Circle 332 on Inquiry Card

Data Converters
Cross-reference chart includes type, bits, speed, package, and size to present group of general purpose devices and their second source equivalents. **ILC Data Device Corp,** Bohemia, NY.
Circle 333 on Inquiry Card

RFI Power Line Filters
Fully illustrated 16-p catalog uses diagrams and spec charts to detail complete line of rfi power line filters. **Curtis Industries, Inc,** Milwaukee, Wis.
Circle 334 on Inquiry Card

LCD Design
Handbook discusses principles of operation, driving techniques, surface treatments, and sealing; it also details multiplex drive techniques and field reliability data. **Seiko Instruments U.S.A., Inc,** Torrance, Calif.
Circle 335 on Inquiry Card

Microcomputers
MSC 8000 series MULTIBUS® microcomputers and software are discussed in illustrated catalog that includes specs for system peripherals, add-in memory, digital and analog I/O, controllers, power supplies, and accessories. **Monolithic Systems Corp,** Englewood, Colo.
Circle 336 on Inquiry Card

Bar Codes and Bar Code Reading
Color brochure explains how optical bar code scanners operate, what types of scanners are available, and how to choose scanning system. **Skan-a-Matic Corp,** Elbridge, NY.
Circle 337 on Inquiry Card

Power Supplies
Specs, photos, and dimensions are included in catalog that describes linear power supplies, convection cooled and fan cooled switchers, dc-dc converters, and test instruments. **ACDC Electronics,** Oceanside, Calif.
Circle 338 on Inquiry Card

Test and Measurement Instrumentation
Catalog provides description, features, specs, application information, and technical data for digital multimeters, electrometers, picoammeters, nanovoltmeters, sources, supplies, and milliohmmeters. **Keithley Instruments, Inc,** Cleveland, Ohio.
Circle 339 on Inquiry Card

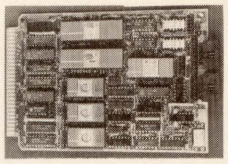
Integrated Circuits
Tables and line drawings are used to describe devices for use in computers, peripherals, data conversion, and special circuit applications. **Components Div, Siemens Corp,** Iselin, NJ.
Circle 340 on Inquiry Card

Electromagnetic Compatibility
Brochure presents guidelines for improving electromagnetic compatibility with shielding, filtering, and electro-optic interconnections, and describes cylindrical, zero insertion force, coaxial, IEEE 488, RS-232, and RS-449 connectors. **AMP Inc,** Harrisburg, Pa.
Circle 300 on Inquiry Card

Protocols
Handy reference card outlines SDLC frame sequence and SNA headers and errors. **Questronics, Inc,** Salt Lake City, Utah.
Circle 251 on Inquiry Card

Videotape Courses
Mini-catalog provides listing of 15 packaged courses on microprocessors and microcomputers. **AMCEE,** Atlanta, Ga.
Circle 276 on Inquiry Card

Electronic Hardware
Photos, specs, and dimensional drawings in catalog describe DIP, transistor, and IC sockets, adapter plugs and covers, plugs and jumpers, and socket and terminal strips. **Samtec, Inc,** New Albany, Ind. Circle 214 on Inquiry Card



dy-4 SYSTEMS ANNOUNCES STD COMPATIBLE STD BUS SINGLE CARD COMPUTER/ CONTROLLER

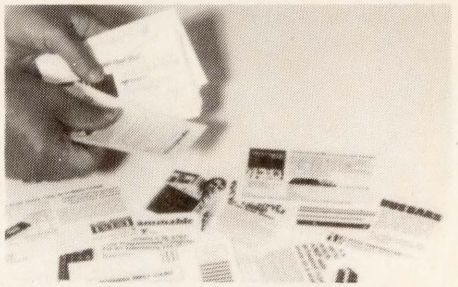
The DSTD-102 is a self contained board-level computer. Module versatility is provided by 3 on-board Bytewide memory (28 Pin) sockets for both ROM/EPROM and/or RAM, 2-RS232C serial ports and 4 counter/ timer/interrupt channels. Additional features include 2.5 or 4.0 MHz operation, programmable wait-state generator and an on-board memory disable capability. Other cards in the DSTD series include 64K Byte dynamic RAM, Serial/Parallel I/O, Quad serial I/O, EAROM/PROM Card and CPU/ Parallel I/O.
dy-4 SYSTEMS INC, 1573 Laperrier Ave, Ottawa, Ontario, Canada K1Z 7T3 (613) 728-3711. **CIRCLE 201**

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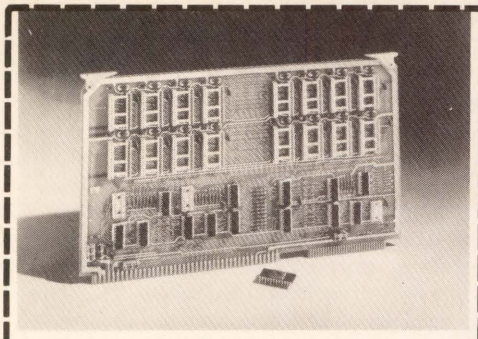
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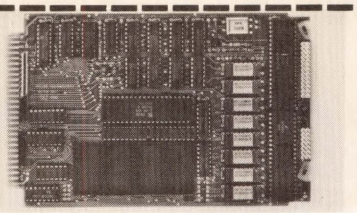
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Contact Maureen Sebastian, **COMPUTER DESIGN,** 11 Goldsmith St. Littleton, MA 01460. (617)486-8944. **CIRCLE 203**



SBC 80 COMPATIBLE 32K PROM BOARD

The PROM-32 accepts sixteen 2716 E-PROMS. The base addresses of the memory fall on 16K boundaries and are settable to 0000, 4000, 8000 and C000 Hex. Any 2K memory block may be deselected. 3 Year Warranty. $295 (Qty 1-9) Stock. **ELECTRONIC SOLUTIONS,** 5780 Chesapeake Ct, San Diego, CA 92123. Tel: (800)854-7086. In California call (714) 292-0242

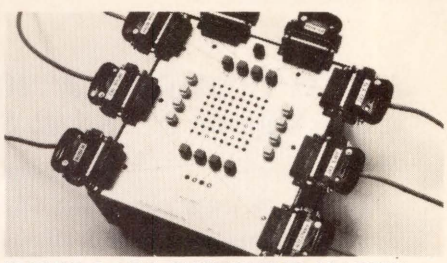
CIRCLE 204



4MHZ Z80A, 64K RAM, 32K ROM, 32 I/O BITS AND SERIAL PORT is only the beginning for the MCPU-800 single board microcomputer. Memory mapping and I/O space expansion under software control assure maximum system flexibility. Optional software includes a hard working Monitor, a control oriented 2K BASIC, and a full function 8K BASIC. Both Basics allow ROM-able statements. Many applications may be served by this card alone, although full STD bus compatibility is maintained for simple customization. 16K RAM MCPU-800 from $675, full 64K for $1175.

MILLER TECHNOLOGY, 647 N. Santa Cruz Ave. Los Gatos, CA 95030 (408) 395-2032.

CIRCLE 205



RS232 DATA SWITCHING MATRIX

· Implements every possible connection between Tx Data and Rcvd Data for eight I/O ports.

· Manual Control and connection monitoring via built in key array and 8 x 8 LED display.

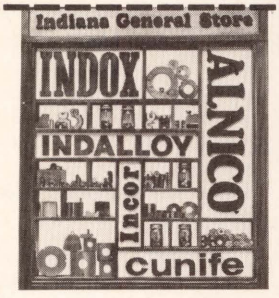
· Non-volatile memory for 16 connection arrangements.

· 20 ma, RS232, or TTL may be mixed.

· Remote selection via parallel TTL interface.

$995 (1-4, USA only), **DIGITAL LABORATORIES,**600 Pleasant St., Watertown, MA 02172. (617)924-1680.

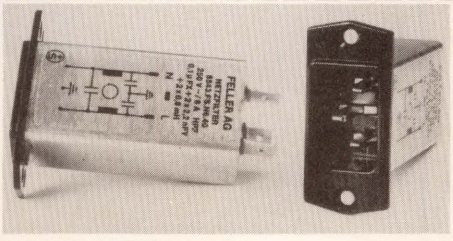
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...Come to the INDIANA GENERAL STORE for high energy cast Alnico ... Sintered Alnico for small, intricate shapes ... Economical Indox® Ceramic magnets ... Cunife close tolerance stamped or formed parts ... Space-saving Incor® Rare Earth Materials with highest energy product available ... High quality Indalloy® formed or machined in intricate parts. Ask for complete file of current permanent magnet technical data. **INDIANA GENERAL — MAGNET PRODUCTS,** 405 Elm St., Valparaiso, IN 46383 (219)462-3131.

CIRCLE 207



INTERNATIONAL RFI POWER LINE FILTERS

Two new international RFI power line filters with integral CEE-22 connectors are recognized, approved, or tested by UL, CSA, SEV, SEMKO, and VDE. Available in 2 and 6 amp configurations, both filters offer attenuation of at least 40 dB from 1 - 100 MHz. Because they satisfy both European and North American test agencies, these filters may be used interchangeably in equipment made for domestic or export markets.

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For Model 1 Operation





488-80C
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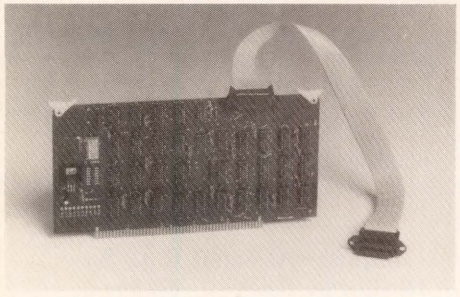
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Telephone: (516) 694-3205

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There is no affiliation between Scientific Engineering Laboratories and Tandy Corp. or Radio Shack.

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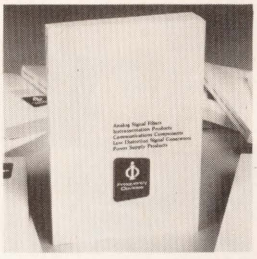


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CONTROL COMPUTER DEVELOPMENT SYSTEM 6800 MPU, serial I/O, 48K RAM, dual 8" drives, WIZRD multitasking DOS, editor, assembler, 16K BASIC, all for $3949. Options; C, PL/W, PASCAL, FORTRAN, EROM programmer, analog I/O, parallel I/O, 488 GPIB interface, CMOS RAM/battery, power fail detect/power on reset.

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CIRCLE 210

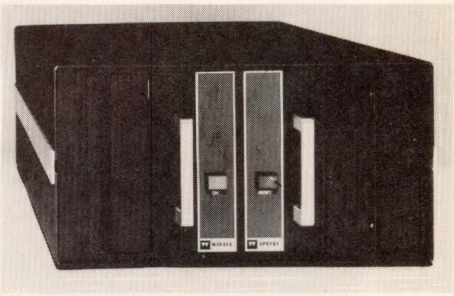


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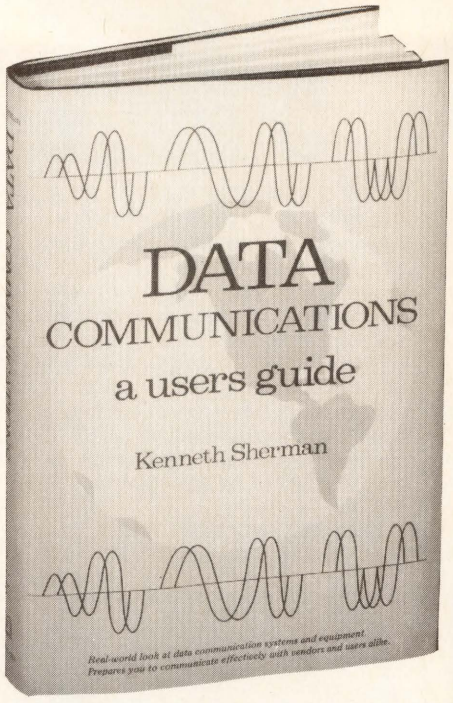
CIRCLE 212

Designer's Bookcase

DATA COMMUNICATIONS a user's guide by *Kenneth Sherman.*

A BRAND NEW quick and effective source for pinpointing and eliminating system malfunctions, discovering new, more efficient data movement, learning effective trouble-shooting, ensuring strong, clear signal transmission and achieving maximum performance and value. Put these *all new* ideas and many others to work for you!

348 pages; 95 illustrations; Reston Publishing Company Inc; $21.95. 1981.
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Computer Capacity: A Production Control Approach by *Melvin J. Strauss.*

Unlike other books that treat computer performance measurement, this practical volume introduces standard industrial production control techniques that show how to deal with daily and weekly variances in utilization, how to quantify the effect of those variances on user service levels, and how to plan capacity and accommodate utilization variances.

280 pages; 6 x 9; 128 illustrations; Van Nostrand Reinhold; $24.95. July, 1981.
Circle 216 on Inquiry Card

Data Base Architecture by *Ivan Flores, Ph.D.*

This is the definitive guide to data base organization, giving the answers to the why's and how's. It describes the structure and use of information organized into a data base, and how application programs, data structures, data base management systems (DBMS), the operating system, and hardware relate to each data base organization.

408 pages; 295 illustrations; 6 x 9; Van Nostrand Reinhold; $26.50. July, 1981.
Circle 217 on Inquiry Card

Switching Power Converters by *Peter Wood.*

For the first time ever, the entire field of switching power converters is covered in one volume. *Switching Power Converters* provides vital information on basic principles, relationships and characteristics of switching power converters, giving the reader the means for acquiring solid design competence.

464 pages; 142 illustrations; 6 x 9; Van Nostrand Reinhold; $26.50. May, 1981.
Circle 218 on Inquiry Card

The Software Legal Book by *Paul S. Hoffman.*

Written by a practicing attorney and CDP holder in non-legal terms. Covers: Protection of proprietary software, ownership of software and modifications, defining deliverables, basic contract provisions, warranties, excusable delays, special contract situations, bundled systems, third party leasing, arbitration, and developing software from contracts.

179 pages; L.L. bound; Carnegie Press; $59.95. 1981. Circle 219 on Inquiry Card

Computer-Assisted Data Base Design by *George U. Hubbard.*

This book not only thoroughly explains the theoretical aspects, but also provides explicit directions on all data base design procedures. In addition to a practical design methodology it discusses the ways to automate the major portions of this methodology. However, all of the techniques can be utilized without computer assistance.

320 pages; 123 illustrations; 6 x 9; Van Nostrand Reinhold Data Processing Series; $24.95. August, 1981. Circle 220 on Inquiry Card

COMPUTER DESIGN
THE MAGAZINE OF COMPUTER BASED SYSTEMS

Designer's Bookcase

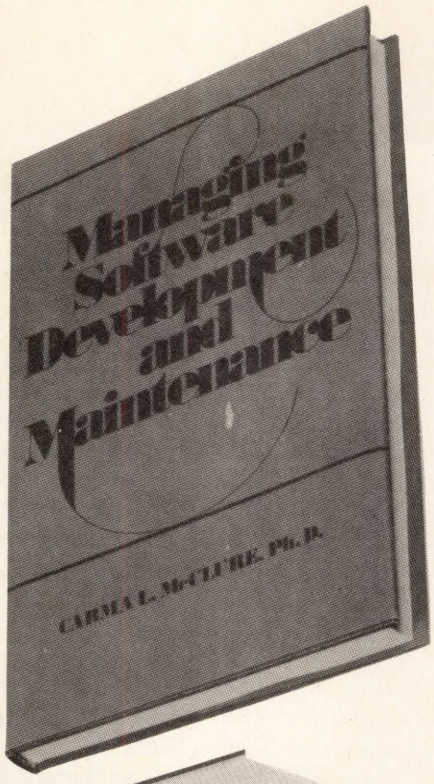
MANAGING SOFTWARE DEVELOPMENT AND MAINTENANCE by *Carma L. McClure, Ph. D*

This book presents practical project management methods that focus on the management and maintenance issues of the software life cycle.

Managing Software Development and Maintenance can help solve a wide range of management and maintenance problems currently encountered in providing to industry high quality software systems within time and budget constraints.

224 pages; 42 illustrations; 6 x 9; Van Nostrand Reinhold; $16.95. Publication date: February 1981.

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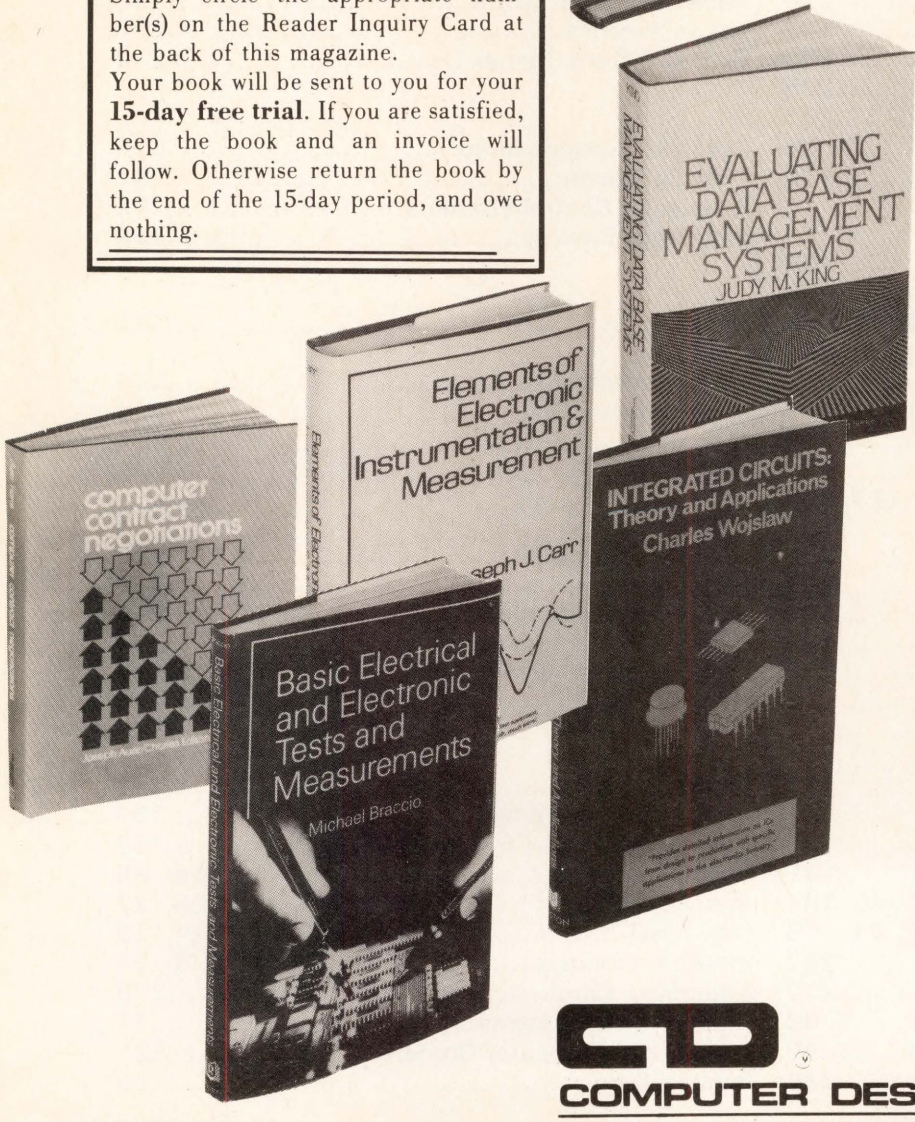


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Computer Contract Negotiations by *Joseph Auer and Charles E. Harris.*

This book provides the interdisciplinary tools necessary for an experienced or inexperienced user to plan, negotiate, and document a complex data processing transaction. Written solely from the standpoint of the user, **Computer Contract Negotiations** shows how to recognize and solve critical problems when contracting for computer systems.

400 pages; 21 illustrations; 6 7/8 x 10; Van Nostrand Reinhold; $34.50. Publication date: July, 1981.

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Evaluating Data Base Management Systems by *Judy M. King.*

Discussed in detail and for the first time are systematic guidelines for choosing the best possible Data Base Management System (DBMS) for a particular organization. Based on the author's extensive work with data base systems at IBM, the book explains how to determine when a DBMS is needed and how and why to establish an evaluation team to investigate the possible choices in software.

296 pages; 57 illustrations; 6 x 9; Van Nostrand Reinhold Data Processing Series; $21.95. Publication date: July, 1981.

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Integrated Circuits: Theory and Application by *Charles Wojslaw*

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248 pages; $16.95. 1978.

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508 pages; $18.95. 1979.

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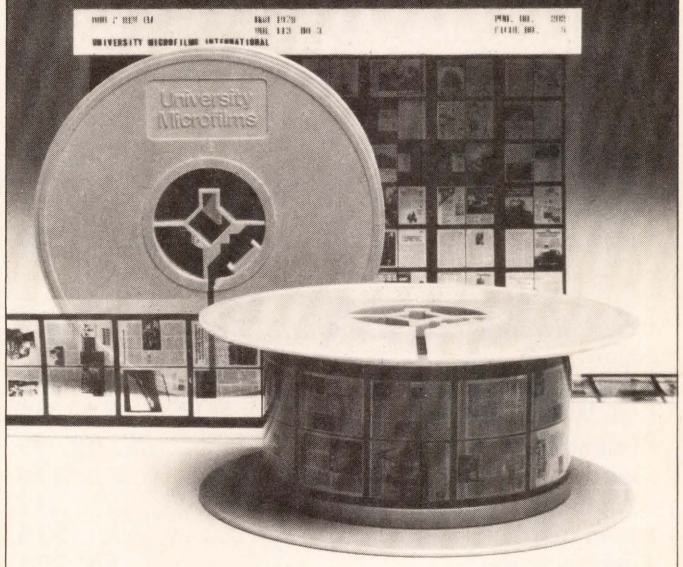
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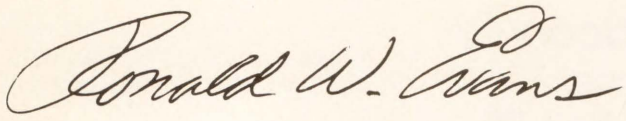
Subjects covered include: A determination of present salaries and anticipated salary increases through 1985. A check on how respondents feel about the area of the country where they presently reside, and a ranking of geographical areas in terms of their willingness to relocate.

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This Career Growth Benchmark Survey is another significant aspect of **COMPUTER DESIGN's** commitment to the design engineer. If you have received one of these questionnaires, please fill it out and return it promptly—your answers are vital to the completed results. In this section during the months ahead, we will be reporting your collective opinions and perceptions in response to this study and others like it.



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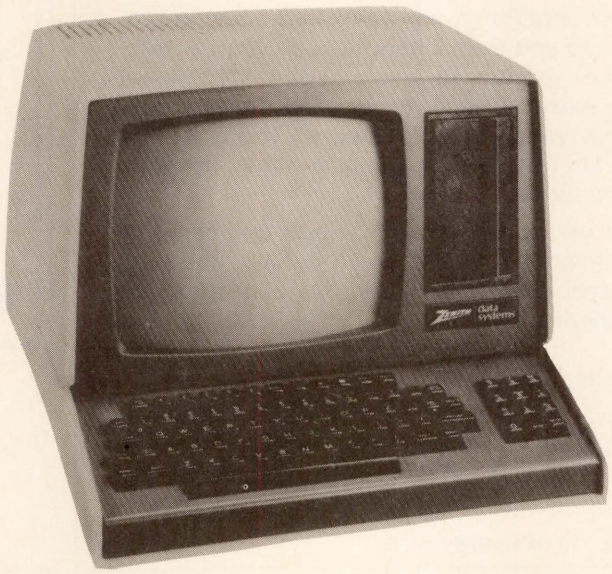
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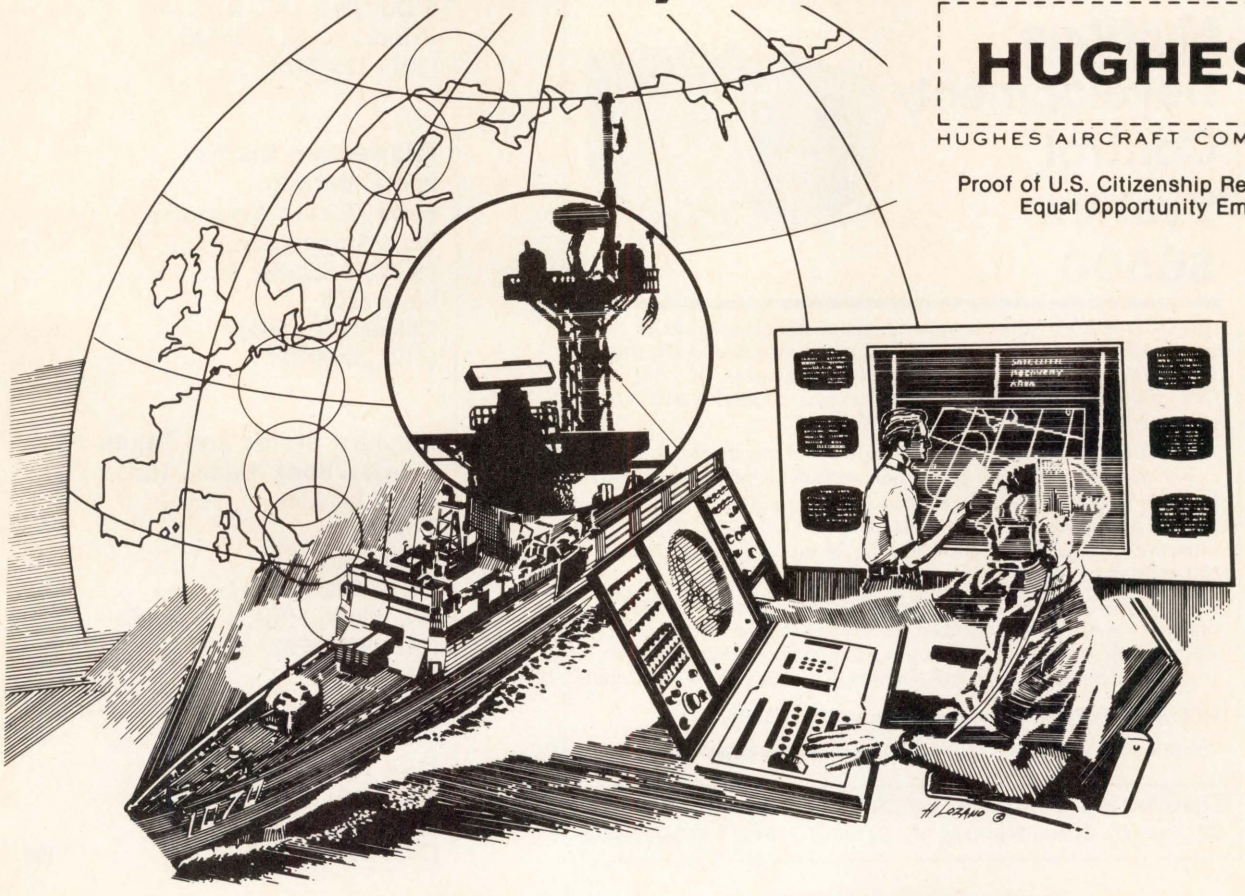
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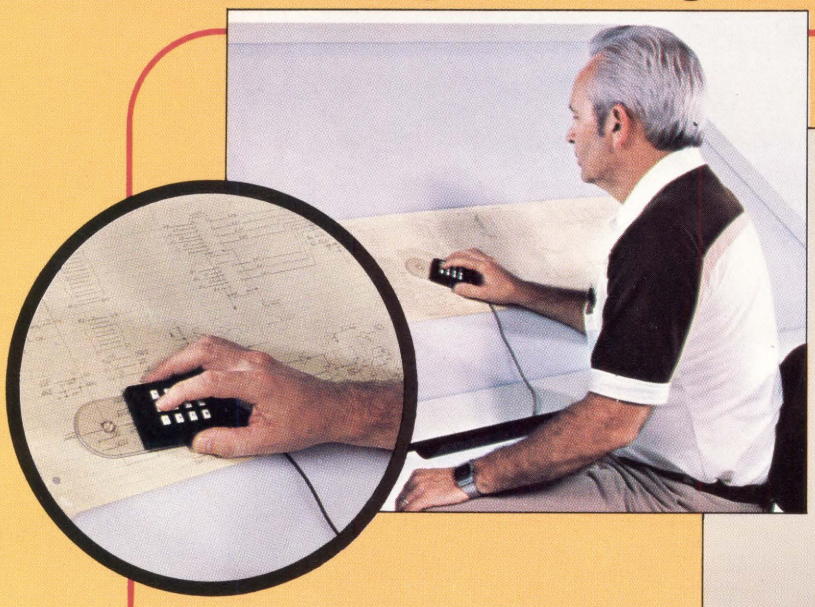
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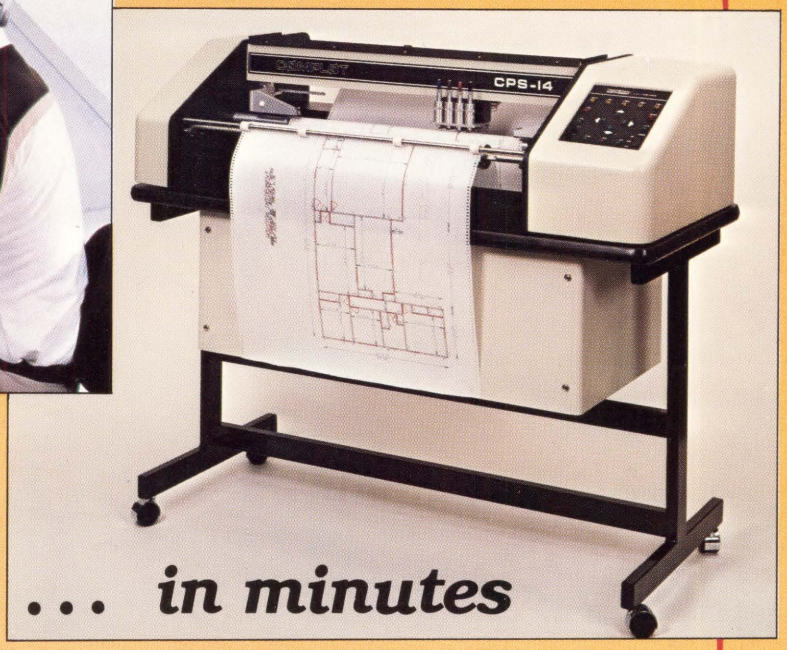
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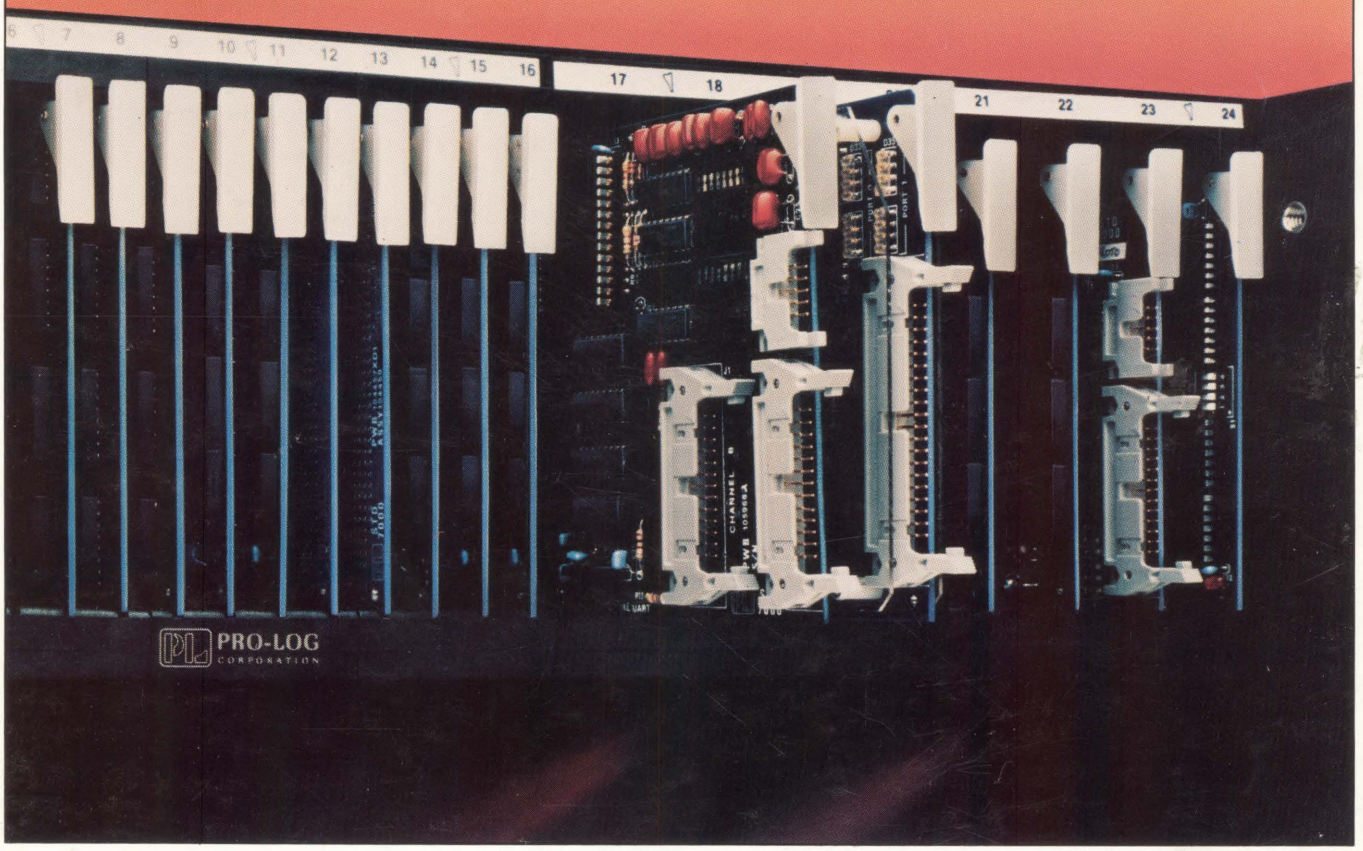
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